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Chapter 1

General Introduction



Introduction

Hospitalized patients are vulnerable to (disease-related) undernutrition. Over the past decades, undernutrition within the hospital setting has increasingly attracted attention both nationally and internationally. Still, undernutrition remains to be a significant problem, affecting approximately one in every four hospital patients (1-3). Undernutrition can originate during hospital admission, but in many patients, undernutrition is already present at time of hospital admission, and nutritional status further deteriorates during hospital admission.

Recognition of undernutrition in the earliest possible stage of disease (i.e. in primary care setting or in the diagnostic outpatient phase) may be essential to prevent a further decline of the nutritional status during disease. To date, possibilities for structural screening and treatment of undernutrition in the outpatient setting have not yet been well explored.

Terminology

In scientific literature, 'undernutrition' and 'malnutrition' are often used interchangeably. Malnutrition is defined as 'a state of nutrition in which a deficiency, excess or imbalance of energy, protein and other nutrients causes measurable adverse effects on tissue/body form (shape, size and composition) and function, and clinical outcome' (4). It is used to describe a wide spectrum of nutritional problems, containing both over- and undernutrition, and considers both macronutrients (carbohydrates, proteins and fats) and micronutrients (vitamins and minerals). Undernutrition is primarily used in the context of deficient energy or protein intake or absorption, among potential other nutrient deficiencies (5). It can be defined as 'a disorder of nutritional status resulting from reduced nutrient intake or impaired metabolism', and is often described as protein energy malnutrition (5;6). This thesis focuses on protein and energy undernutrition. Throughout this thesis, the term (disease-related) undernutrition will be used.

Causes of undernutrition

Undernutrition occurs along a continuum of reduced nutritional intake and/or increased requirements, malabsorption, and changes in metabolism (increased catabolism), and it can be associated with both acute and chronic disease (7). Its pathogenesis is multifactorial and complex; undernutrition can be caused by a combination of somatic, functional, psychological and social factors (8). In hospitalized patients, deteriorated nutritional status seems inevitably caused by (somatic and/or functional) disease-related factors, such as loss of appetite, inflammation, mechanical obstructions of the

gastrointestinal tract, swallowing difficulties, or pain during eating. During treatment, treatment-related factors, such as episodes of fasting, or side effects of treatment or medication may contribute to origination of undernutrition or deterioration of nutritional status (1;9). But also psychological (anxiety, depression, loneliness) or social factors (difficulties with shopping or preparing meals, poverty) may contribute to a poor nutritional condition (10) even before hospital admission or initiation of treatment.

Undernutrition is a complex syndrome (11). Twenty years ago, undernutrition was mainly described as clinical depletion ('a state resulting from lack of uptake or intake of nutrition, leading to altered body composition, reflected by a decreased body cell mass (BCM), and diminished function' (12)). In recent years, a distinction is made between different multifactorial metabolic and nutritional syndromes (7), such as wasting (loss of both muscle and fat mass following nutritional deficiency or starvation (13)), cachexia (loss of body weight and muscle, and increased catabolism due to underlying disease(s) (14;15)) and sarcopenia ((age-related) loss of muscle mass and muscle strength resistance (15;16)), which can originate in the presence or absence of reduced nutritional intake. In practice, these syndromes are difficult to differentiate, as the causative underlying conditions may overlap, and syndromes can be present together (17).

Consequences

Undernutrition and specifically loss of body protein mass may influence a patient's general health status, his recovery and prognosis. Many studies have shown that undernutrition is associated with extensive adverse consequences on clinical outcomes, such as: reduced muscle strength (18), impaired wound healing (19;20), and a higher risk of infectious and noninfectious (postoperative) complications (21-23). These adverse clinical outcomes may lead to prolonged recovery, longer length of hospitalization and a higher readmission rate (1;24-27), impaired quality of life (28;29), and increased mortality (1;25-27). Accordingly, undernutrition contributes to considerable health care costs; the additional costs of undernutrition in the Netherlands were estimated to be 1.9 billion euro in 2011 (30).

Assessment of undernutrition

The assessment of (disease-related) undernutrition is complex, due to its causative underlying conditions. Hence, to date no universally accepted definition of (disease-related) undernutrition has been established (31). However, two criteria for defining undernutrition are commonly used and acknowledged, both nationally and internationally: (1) unintentional weight loss, and (2) low Body Mass Index (BMI; body

weight (kg) divided by height (m) squared) (4;5;32). The unintentional character is essential, as unintentional weight loss has been shown to be related to a significant increase in mortality, whereas intentional weight loss had no effect on mortality (33;34). Low BMI may indicate chronic undernutrition, more frequently observed in patients with chronic diseases and in older adults in the general population (35), whereas unintentional weight loss indicates more acute deterioration of nutritional status, as observed in hospitalized patients (11) or patients receiving home care (35). The Dutch Malnutrition Steering Group generally defines undernutrition in adults according to the criteria described in **Figure 1**, but further diagnostics are always indicated to establish the severity and underlying causes of undernutrition and to establish a proper treatment plan.

Undernutrition

- Unintentional weight loss:
 - more than 10% in the past 6 months; and/or
 - more than 5% in the last month; and/or
- Low Body Mass Index:
 - BMI below 18.5 kg/m² (adults < 65 years); and/or
 - BMI below 20.0 kg/m² (adults ≥ 65 years).

Figure 1. General definition of undernutrition according to the Guideline 'Screening and treatment of malnutrition' as approved by the Dutch Malnutrition Steering Group and Dietitians Malnutrition Netherlands (36).

Screening and treatment in hospital inpatients

Early recognition is a first step towards optimal treatment of undernutrition. Early recognition and treatment of undernutrition in the hospital setting requires a multidisciplinary approach involving medical and nursing staff, dietitians, nutrition assistants, but also hospital management. In the absence of formal screening procedures, recognition of undernutrition by medical staff is low (37-40), which emphasizes the need for systematic screening.

Screening instruments

In order to facilitate early recognition of undernourished hospital patients, numerous screening tools have been developed to assess (the risk of) undernutrition. Screening instruments contain various measures, such as questions on weight change, intake and appetite, calculation of BMI, indications of disease severity, anthropometric

measurements, clinical assessment, and laboratory values (41;42). Within the range of screening tools, a division can be made between 'quick-and-easy' tools, that do not require any calculation (e.g. SNAQ (43), MST (44)) and more complex instruments, involving calculations and/or measurements (e.g. MUST (45), NRS-2002 (46), MNA-SF (47)).

Undernutrition screening in the hospital setting – The Dutch Approach

In 2000, the Dutch Dietetic Association conducted a national campaign 'Eat well to get well' (*Wie beter eet wordt Sneller Beter*) to increase the awareness for the problem of undernutrition among health care professionals and in society. This campaign was followed by the first national screening survey, aiming to determine the prevalence of disease-related malnutrition in The Netherlands in all fields of medical care and to investigate the involvement of the dietician in the treatment of malnutrition. The study showed that, despite the high prevalence of undernutrition (25%) and overall awareness of the negative consequences, half of all undernourished hospital patients remained unrecognized, and thus untreated (38).

In the years following, disease-related undernutrition became an item of political debate and easy-to-use screening tools for all care settings were developed (43;48;49). Undernutrition was included in the annual National Prevalence Measurement of Care Problems (LPZ; 2004) and the multidisciplinary Dutch Malnutrition Steering Group (DMG) was established (2005).

In the Netherlands, consensus has been reached on the implementation of the SNAQ (**Figure 2**) and MUST (**Figure 3**) screening tools in the hospital setting in 2005 (50). Implementation of systematic nutritional screening was guided by a national implementation program 'Early recognition and optimal treatment of undernutrition in hospitals' established by the Dutch Malnutrition Steering Group. The implementation program was part of a national care quality improvement campaign funded by the Dutch Ministry of Health, Welfare and Sports, and aimed to (1) implement screening of all hospitalized patients at admission and (2) to provide optimal nutritional treatment for undernourished patients. Between 2006 and 2009, 57 hospitals participated in the program, covering more than 50% of all Dutch hospitals.

<h1>SNAQ</h1> <h2>Short Nutritional Assessment Questionnaire</h2>	
<ul style="list-style-type: none">• Did you lose weight unintentionally? More than 6 kg in the last 6 months More than 3 kg in the last month	<div><div>● ● ●</div><div>● ●</div></div>
<ul style="list-style-type: none">• Did you experience a decreased appetite over the last month?	<div><div>●</div></div>
<ul style="list-style-type: none">• Did you use supplemental drinks or tube feeding over the last month?	<div><div>●</div></div>
<div><div>●</div> no intervention</div> <div><div>● ●</div> moderately malnourished; nutritional intervention</div> <div><div>● ● ●</div> severely malnourished; nutritional intervention and treatment dietician</div>	

Figure 2. Short Nutritional Assessment Questionnaire (SNAQ) (43).

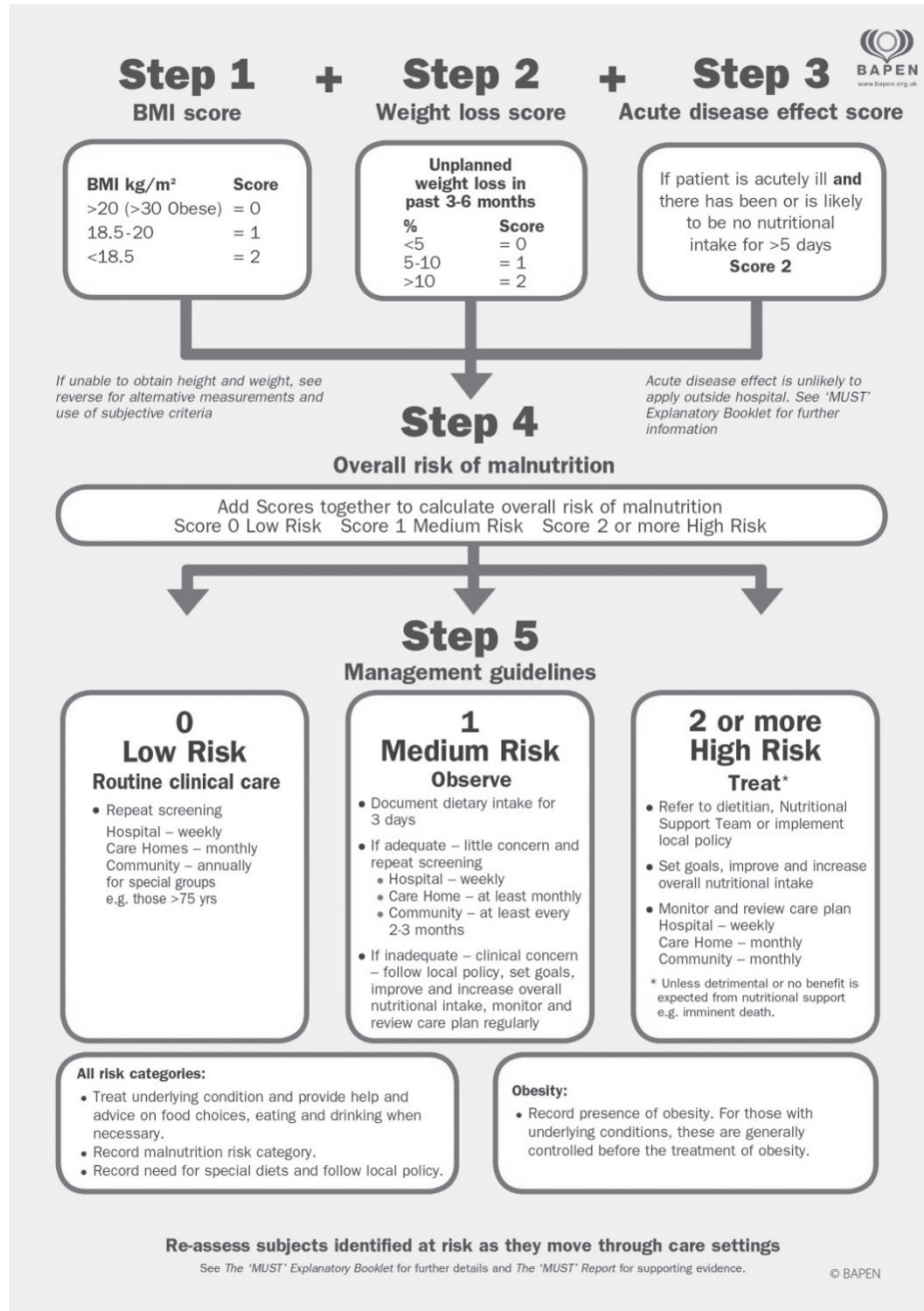


Figure 3. Malnutrition Universal Screening Tool (MUST) (45).

Resulting from a collaboration between the Dutch Malnutrition Steering Group and the Dutch Ministry of Health, Welfare and Sports, systematic screening for undernutrition in hospitalized patients was introduced as a performance indicator (PI) within the National Benchmarks on Quality of Care of the Dutch Health Care Inspectorate (HCI) as of 2007 (51). Annually, hospitals are required to report on a variety of care processes to the HCI. Results are used to create transparency on quality of care and to rate the performance of Dutch hospitals. Embedding nutritional screening in this benchmark system obliges hospitals to annually report information on the number of patients screened for undernutrition at hospital admission and on the prevalence of undernutrition at admission. A consensus-based target of 90% should be pursued by all hospitals.

Prevalence of undernutrition in hospital patients

The prevalence of disease-related undernutrition depends on the health care setting and the characteristics of the study population, such as age, and nature and severity of underlying disease, as well as the criteria used to determine (the severity of) undernutrition. As different countries use different definitions to measure undernutrition, and even within countries different definitions are being used, the prevalence rates described may largely differ between studies.

Since 2004, in the Netherlands, the prevalence of undernutrition in the hospital setting, amongst other health care settings is annually being measured as part of the Dutch National Prevalence Measurement of Care Problems (LPZ). Based on an advisory report on undernutrition in older individuals published by the Health Council of the Netherlands in 2011 ('Malnutrition in the elderly') (52), LPZ has changed its criteria in 2013, leaving out the aspect of low or no nutritional intake (**Table 1**) (2). Since 2007 the prevalence undernutrition based on screening outcome in the hospital setting is also measured by the HCI. In both studies, results should be interpreted as the percentage of patients at risk of undernutrition rather than the actual assessment of undernutrition. The difference in prevalence rates according to both methods (**Table 2**) provides an example of the effect of using different criteria to classify undernutrition in the same population. Still, the high prevalence of hospital undernutrition emphasizes the importance of recognition and treatment of undernutrition in this setting.

Table 1. Criteria for severe and moderate undernutrition used in LPZ and HCI studies.

Study	Criteria undernutrition
LPZ (2004-2012)	<p>Severe undernutrition</p> <ul style="list-style-type: none"> BMI < 18.5 kg/m² (<65 years) or BMI < 20.0 kg/m² (≥ 65 years); unintentional weight loss > 6 kg in previous 6 months or > 3 kg in previous month; BMI 18.5-20.0 kg/m² (<65 years) or BMI 20.0-23.0 kg/m² (≥ 65 years) combined with no nutritional intake for 3 days or reduced intake > 7 days <p>Moderate undernutrition</p> <ul style="list-style-type: none"> BMI 18.5-20.0 kg/m² (<65 years) or BMI 20.0-23.0 kg/m² (≥ 65 years) no nutritional intake for 3 days or reduced intake > 7 days
LPZ (2013)	<p>Severe undernutrition</p> <ul style="list-style-type: none"> BMI < 18.5 kg/m² (<65 years) or BMI ≤ 20.0 kg/m² (≥ 65 years); unintentional weight loss > 10% in previous 6 months or > 5% in previous month <p>Moderate undernutrition</p> <ul style="list-style-type: none"> unintentional weight loss 5-10% in previous 6 months
HCI	<p>Severe undernutrition</p> <ul style="list-style-type: none"> SNAQ ≥ 3 points MUST ≥ 2 points <p>Moderate undernutrition</p> <ul style="list-style-type: none"> SNAQ = 2 points MUST = 1 point

LPZ, Dutch National Prevalence Measurement of Care Problems; HCI, Health Care Inspectorate; SNAQ, Short Nutritional Assessment Questionnaire; MUST, Malnutrition Universal Screening Tool.

Table 2. Prevalence of severe and moderate undernutrition in hospitals in LPZ and HCI studies.

Study	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
<i>LPZ</i>										
Severe	29%	29%	27%	27%	26%	26%	25%	25%	22%	10%
Moderate	20%	22%	21%	23%	25%	24%	24%	26%	19%	3%
<i>HCI</i>										
Severe	-	-	-	18%	17%	16%	15%	16%	14%	-
Moderate	-	-	-	7%	6%	6%	5%	4%	5%	-

LPZ, Dutch National Prevalence Measurement of Care Problems; HCI, Health Care Inspectorate.

Treatment of undernutrition in hospital patients

Treatment of undernutrition is intended to reduce the negative effects of catabolism and aims to restore the energy and protein balance in order to minimize the loss of body protein mass (7;15;53). The standard treatment of undernutrition therefore focuses on providing the patient with an optimal amount of energy and protein, preferentially based on individual requirements. The protein target for hospitalized patients is currently defined as 1.2-1.5 gram per kg body weight per day (54-58). The energy target is defined by estimated resting energy expenditure (REE) using the Harris and Benedict (HB) equation (59) with an additional factor for either activity or disease, frequently estimated at 30% (53;55;60).

Nutritional intake should preferably be improved by ordinary foods and beverages (high in protein and energy) and provision of in-between snacks, but oral nutritional supplements (ONS), sip feeding or even parenteral nutrition could be provided if nutritional intake remains insufficient (36).

Treatment of undernutrition in the hospital setting – The Dutch Approach

As described earlier, one of the aims of the Dutch Malnutrition Steering Group's implementation program 'Early recognition and optimal treatment of undernutrition in hospitals' was to provide optimal nutritional treatment for undernourished hospitalized patients. Optimal nutritional treatment includes **(Figure 4)** (36):

- Structural screening of all patients at hospital admission;
- Assessment of severity and nature of undernutrition by a professional (including nutritional intake and requirements, body composition, inflammation, and functional, medical and social factors);
- Timely initiation of nutritional treatment;
- Regular evaluation of the treatment plan with regard to energy and protein intake.

Assessing the protein intake on day 4 of admission was chosen as a structural evaluation point, so that the initiated treatment can be adjusted timely when protein and energy targets are not met.

In 2008, treatment of undernutrition was added to the undernutrition performance indicator of the HCI. For this quality indicator hospitals must annually report on the number of undernourished patients with an adequate protein intake (of at least 1.2-1.5 g/kg body weight) on day 4 of admission.

Achieving the protein (and energy) target is expected to be influenced by numerous patient-bound factors (e.g. disease, nil by mouth regimen). Even with optimal hospital conditions, a 100% score on this indicator will not be feasible in practice. Therefore, a percentage of 60% of undernourished patients with adequate intake is set as a minimal standard.

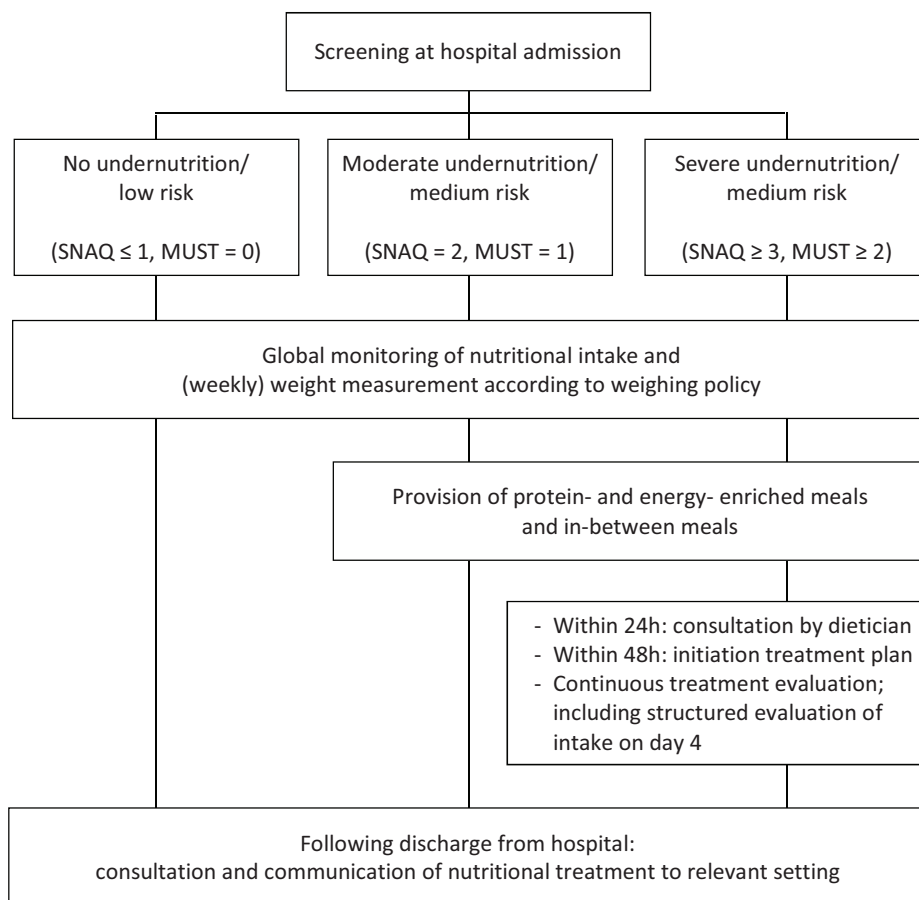


Figure 4. Multidisciplinary treatment plan following structural screening at hospital admission advised by the Dutch Malnutrition Steering Group.

A brief overview of the Dutch actions to fight malnutrition is given in **Table 3**. The Netherlands was the first country with national regulations on mandatory screening and treatment of undernutrition in the hospital setting. Both performance indicators, therefore, present a unique database on quality of care based on more than 1 million admissions each year. In the reports of the HCI, hospitals show large differences in screening and treatment results. Underlying reasons for these differences are currently unknown.

Table 3 Developments to tackle undernutrition in The Netherlands.

2000	National campaign 'Eat well to get well'
2001	First national screening survey
2004	First National Prevalence Measurement of Care Problems (LPZ)
2004	Development of Short Nutritional Assessment Questionnaire (SNAQ); undernutrition screening instrument for hospitals
2005	Dutch Malnutrition Steering Group (DMG) established
2006 - 2009	Implementation program in hospitals; 'Early recognition and optimal treatment of undernutrition in hospitals'
2007	Performance indicator screening undernutrition (hospital patients)
2007	Guideline 'Perioperative Nutrition' (CBO)
2008	Performance indicator treatment undernutrition (hospital patients)

Shift to outpatient setting

As a result of substantial and ongoing medical developments, hospitalization time has significantly declined over the past decades. Hospital care is shifting more and more towards daycare and the outpatient setting. Whereas in the 1950s the average hospital admission time was around 20 days (61), the average clinical admission time in 2012 had declined to 4.8 days excluding daycare (62) or 2.8 days including daycare (63). Due to this shortened hospitalization period, there is a limited time frame for optimal nutritional care during hospital admission. This leads to a situation where undernutrition can be identified during hospital admission and nutritional treatment can be initiated. Continued nutritional support should take place during the post-discharge rehabilitation period.

On the other hand, the number of hospital outpatient visits per 100 residents increased from 144 to 178 between 2002 and 2010 (64). A significant number of diagnostic outpatient visits will lead to either a hospital admission or daycare treatment: 17.7 hospital admissions and 20.2 daycare treatments per 100 first outpatient visits (62). This makes the outpatient clinic a promising setting for early nutritional screening. Outpatient screening enables us to identify patients with (a risk of) undernutrition and to improve a

patient's nutritional status before the actual start of medical treatment or hospital admission. Also, continued outpatient treatment will facilitate the monitoring of weight change during medical treatment or post-treatment. It is hypothesized that more timely recognition and initiation of undernutrition treatment will lead to a nutritionally better starting position for treatment or admission, which might lead to less impact of nutritional deterioration during the course of treatment, and/or might diminish the negative consequences of undernutrition with regard to prognosis (**Figure 1.5**). However, to date, no data exist to test this hypothesis.

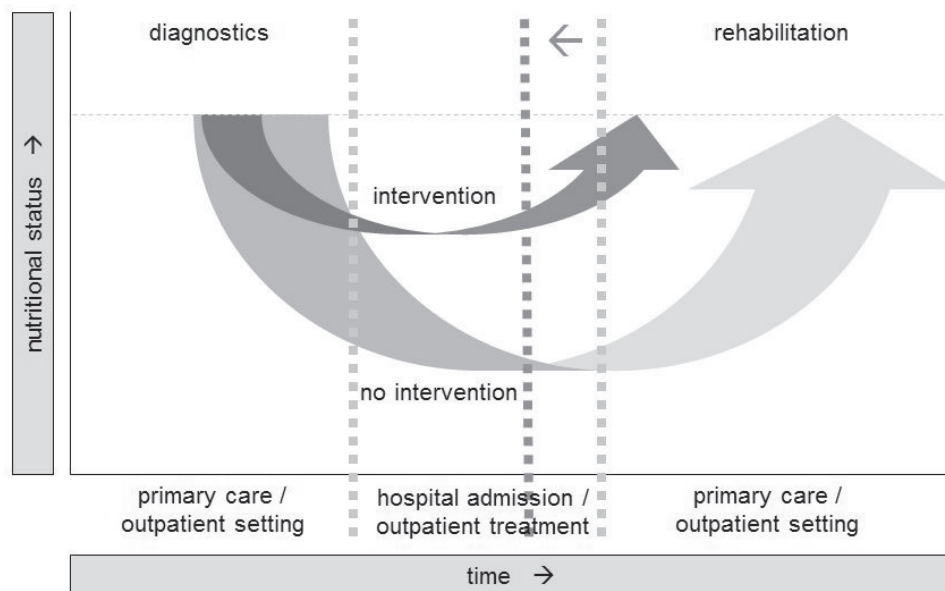


Figure 5. Change in nutritional status during course of treatment.

At the initiation of the research described in this thesis, screening in the hospital outpatient setting was not structurally implemented, due to various factors. Firstly, hospitals were focused on implementing and/or improving systematic nutritional screening in the inpatient setting. Secondly, prevalence data were lacking to support the initiation of screening. Only few studies had been performed assessing the prevalence of undernutrition in hospital outpatients, suggesting prevalence rates between 6-12% depending on age and diagnosis (65;66). Thirdly, none of the existing screening tools had been specifically developed for or validated in an outpatient setting.

In order to realize nutritional screening in the outpatient setting, the diagnostic accuracy of screening tools should be studied in this setting. Moreover, the prevalence of undernutrition in this setting should be established. The prevalence of undernutrition is likely to vary between different outpatient departments (e.g. a low prevalence in the department of gynecology). This implies the need for determining high-risk outpatient departments, so that screening can be initiated in the departments where patients are most at risk for undernutrition. Finally the effect of early recognition and treatment of undernutrition on relevant outcomes should be studied, in order to give recommendations on implementation of undernutrition screening and treatment in this setting.

Outline of this thesis

This thesis focuses on undernutrition in the hospital inpatient and outpatient setting. The first objective of this thesis is to identify barriers and enablers for successful implementation of screening and treatment of undernutrition in hospital inpatients. The second objective is to investigate possibilities for recognition and the effect of early recognition and treatment of undernutrition in (high risk) outpatient departments.

Hospital inpatients

- **Chapter 2** describes the undernutrition screening results reported to the Dutch Health Care Inspectorate between 2007 and 2010 and identifies predictive factors for achieved screening results in hospitals.
- **Chapter 3** focuses on treatment of hospital undernutrition and investigates predictors for achieving protein and energy requirements on the fourth day of admission in undernourished hospitalized patients.

Hospital outpatients

- In **Chapter 4** the prevalence of undernutrition in 2288 hospital outpatients was studied and high-risk departments were defined.
- In **Chapter 5** the diagnostic accuracy of the MUST (Malnutrition Universal Screening Tool) and SNAQ (Short Nutritional Assessment Questionnaire) screening tools for undernutrition screening in hospital outpatients was assessed.
- In **Chapter 6** the effect of early individualized dietary counseling (initiated at first outpatient visit) in patients with head and neck cancer on weight loss, complications and length of hospital stay is evaluated.

In **Chapter 7** the main findings of our studies are summarized, methodological issues are discussed, and implications for practice, policy, and future research are portrayed.

References

1. Norman K, Pichard C, Lochs H, Pirlich M. Prognostic impact of disease-related malnutrition. *Clin Nutr* 2008;27:5-15.
2. Halfens RJG, van Nie NC, Meijers JMM et al. Rapportage resultaten Landelijke Prevalentiemeting Zorgproblemen (National Prevalence Measurement of Care Problems). 2013. Maastricht, Maastricht University.
3. Dutch Health Care Inspectorate. 'Het resultaat telt 2012' (The result counts). 2014. Utrecht.
4. Stratton RJ, Green CJ, Elia M. Scientific Criteria for Defining Malnutrition. 1 ed. In: Stratton RJ, Green CJ, Elia M, eds. *Disease-related Malnutrition: An Evidence-based Approach to Treatment*. Cambridge: CABI Publishing 2003:1-34.
5. Lochs H, Allison SP, Meier R et al. Introductory to the ESPEN Guidelines on Enteral Nutrition: Terminology, definitions and general topics. *Clin Nutr* 2006;25:180-6.
6. A.S.P.E.N. Standards for Nutrition Support: Hospitalized Patients. The American Society for Parenteral and Enteral Nutrition. *Nutr Clin Pract* 1995;10:208-19.
7. Jensen GL, Bistrian B, Roubenoff R, Heimbürger DC. Malnutrition syndromes: a conundrum vs continuum. *JPEN J Parenter Enteral Nutr* 2009;33:710-6.
8. Rubenstein LZ, Harker J, Guigoz Y, Vellas B. Comprehensive geriatric assessment (CGA) and the MNA: an overview of CGA, nutritional assessment, and development of a shortened version of the MNA. *Nestle Nutr Workshop Ser Clin Perform Programme* 1999;1:101-15.
9. Stratton RJ, Green CJ, Elia M. Causes of Disease-related Malnutrition. 1 ed. In: Stratton RJ, Green CJ, Elia M, eds. *Disease-related Malnutrition: An Evidence-based Approach to Treatment*. Cambridge: CABI Publishing 2003:93-112.
10. Nieuwenhuizen WF, Weenen H, Rigby P, Hetherington MM. Older adults and patients in need of nutritional support: review of current treatment options and factors influencing nutritional intake. *Clin Nutr* 2010;29:160-9.
11. Kruizenga HM, de Jonge P, Seidell JC et al. Are malnourished patients complex patients? Health status and care complexity of malnourished patients detected by the Short Nutritional Assessment Questionnaire (SNAQ). *Eur J Intern Med* 2006;17:189-94.
12. Schols AM, Soeters PB, Dingemans AM, Mostert R, Frantzen PJ, Wouters EF. Prevalence and characteristics of nutritional depletion in patients with stable COPD eligible for pulmonary rehabilitation. *Am Rev Respir Dis* 1993;147:1151-6.
13. Soeters PB, Reijven PL, van Bokhorst-de van der Schueren MA et al. A rational approach to nutritional assessment. *Clin Nutr* 2008;27:706-16.
14. Fearon K, Strasser F, Anker SD et al. Definition and classification of cancer cachexia: an international consensus. *Lancet Oncol* 2011;12:489-95.
15. Muscaritoli M, Anker SD, Argiles J et al. Consensus definition of sarcopenia, cachexia and pre-cachexia: Joint document elaborated by Special Interest Groups (SIG) "cachexia-anorexia in chronic wasting diseases" and "nutrition in geriatrics". *Clin Nutr* 2010;29:154-9.

16. Cruz-Jentoft AJ, Baeyens JP, Bauer JM et al. Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People. *Age Ageing* 2010;39:412-23.
17. Jeejeebhoy KN. Malnutrition, fatigue, frailty, vulnerability, sarcopenia and cachexia: overlap of clinical features. *Curr Opin Clin Nutr Metab Care* 2012;15:213-9.
18. Norman K, Schutz T, Kemps M, Josef Lübke H, Lochs H, Pirlich M. The Subjective Global Assessment reliably identifies malnutrition-related muscle dysfunction. *Clin Nutr* 2005;24:143-50.
19. Russell L. The importance of patients' nutritional status in wound healing. *Br J Nurs* 2001;10(6):S42-S49.
20. Stechmiller JK. Understanding the role of nutrition and wound healing. *Nutr Clin Pract* 2010;25:61-8.
21. Schneider SM, Veyres P, Pivot X et al. Malnutrition is an independent factor associated with nosocomial infections. *Br J Nutr* 2004;92:105-11.
22. Paillaud E, Herbaud S, Caillet P, Lejonc JL, Campillo B, Bories PN. Relations between undernutrition and nosocomial infections in elderly patients. *Age Ageing* 2005;34:619-25.
23. Naber TH, Schermer T, de BA et al. Prevalence of malnutrition in nonsurgical hospitalized patients and its association with disease complications. *Am J Clin Nutr* 1997;66:1232-9.
24. Kyle UG, Pirlich M, Lochs H, Schuetz T, Pichard C. Increased length of hospital stay in underweight and overweight patients at hospital admission: a controlled population study. *Clin Nutr* 2005;24:133-42.
25. Correia MI, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. *Clin Nutr* 2003;22:235-9.
26. Lim SL, Ong KC, Chan YH, Loke WC, Ferguson M, Daniels L. Malnutrition and its impact on cost of hospitalization, length of stay, readmission and 3-year mortality. *Clin Nutr* 2012;31:345-50.
27. Agarwal E, Ferguson M, Banks M et al. Malnutrition and poor food intake are associated with prolonged hospital stay, frequent readmissions, and greater in-hospital mortality: results from the Nutrition Care Day Survey 2010. *Clin Nutr* 2013;32:737-45.
28. Capuano G, Gentile PC, Bianciardi F, Tosti M, Palladino A, Di PM. Prevalence and influence of malnutrition on quality of life and performance status in patients with locally advanced head and neck cancer before treatment. *Support Care Cancer* 2010;18:433-7.
29. Thomas DR. The critical link between health-related quality of life and age-related changes in physical activity and nutrition. *J Gerontol A Biol Sci Med Sci* 2001;56:M599-M602.
30. Freijer K, Tan SS, Koopmanschap MA, Meijers JM, Halfens RJ, Nuijten MJ. The economic costs of disease related malnutrition. *Clin Nutr* 2013;32:136-41.
31. Meijers JM, van Bokhorst-de van der Schueren MA, Schols JM, Soeters PB, Halfens RJ. Defining malnutrition: mission or mission impossible? *Nutrition* 2010;26:432-40.
32. Detsky AS, Smalley PS, Chang J. Is this patient malnourished? *JAMA* 1994;271:54-8.
33. Harrington M, Gibson S, Cottrell RC. A review and meta-analysis of the effect of weight loss on all-cause mortality risk. *Nutr Res Rev* 2009;22:93-108.

34. Wijnhoven HA, van Zon SK, Twisk J, Visser M. Attribution of Causes of Weight Loss and Weight Gain to 3-Year Mortality in Older Adults: Results From the Longitudinal Aging Study Amsterdam. *J Gerontol A Biol Sci Med Sci* 2014;doi: 10.1093/gerona/glu005.
35. Schilp J, Kruizenga HM, Wijnhoven HA et al. High prevalence of undernutrition in Dutch community-dwelling older individuals. *Nutrition* 2012;28:1151-6.
36. Dutch Malnutrition Steering Group. Guideline Screening and treatment of malnutrition. 2011. Amsterdam.
37. Kondrup J, Johansen N, Plum LM et al. Incidence of nutritional risk and causes of inadequate nutritional care in hospitals. *Clin Nutr* 2002;21:461-8.
38. Kruizenga HM, Wierdsma NJ, van Bokhorst-de van der Schueren MA et al. Screening of nutritional status in The Netherlands. *Clin Nutr* 2003;22:147-52.
39. Elia M, Zellipour L, Stratton RJ. To screen or not to screen for adult malnutrition? *Clin Nutr* 2005;24:867-84.
40. Bavelaar JW, Otter CD, van Bodegraven AA, Thijs A, van Bokhorst-de van der Schueren MA. Diagnosis and treatment of (disease-related) in-hospital malnutrition: the performance of medical and nursing staff. *Clin Nutr* 2008;27:431-8.
41. Van Venrooij LMW, De Vos R, Borgmeijer-Hoelen AMMJ, Kruizenga HM, Jonkers-Schuitema CF, de Mol BMAJ. Quick-and-easy screening tool to detect disease-related undernutrition in a hospital in- and out-patient setting: a systematic review. *e-SPEN, the European e-Journal of Clinical Nutrition and Metabolism* 2007;2007:21-37.
42. van Bokhorst-de van der Schueren MA, Guaitoli PR, Jansma EP, de Vet HC. Nutrition screening tools: does one size fit all? A systematic review of screening tools for the hospital setting. *Clin Nutr* 2014;33:39-58.
43. Kruizenga HM, Seidell JC, de Vet HC, Wierdsma NJ, van Bokhorst-de van der Schueren MA. Development and validation of a hospital screening tool for malnutrition: the short nutritional assessment questionnaire (SNAQ). *Clin Nutr* 2005;24:75-82.
44. Ferguson M, Capra S, Bauer J, Banks M. Development of a valid and reliable malnutrition screening tool for adult acute hospital patients. *Nutrition* 1999;15:458-64.
45. Stratton RJ, Hackston A, Longmore D et al. Malnutrition in hospital outpatients and inpatients: prevalence, concurrent validity and ease of use of the 'malnutrition universal screening tool' ('MUST') for adults. *Br J Nutr* 2004;92:799-808.
46. Kondrup J, Rasmussen HH, Hamberg O, Stanga Z. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials. *Clin Nutr* 2003;22:321-36.
47. Rubenstein LZ, Harker JO, Salva A, Guigoz Y, Vellas B. Screening for undernutrition in geriatric practice: developing the short-form mini-nutritional assessment (MNA-SF). *J Gerontol A Biol Sci Med Sci* 2001;56:M366-M372.
48. Kruizenga HM, de Vet HC, Van Marissing CM et al. The SNAQRC, an Easy Traffic Light System as a First Step in the Recognition of Undernutrition in Residential Care. *J Nutr Health Aging* 2010;14:83-9.

49. Wijnhoven HA, Schilp J, van Bokhorst-de van der Schueren MA et al. Development and validation of criteria for determining undernutrition in community-dwelling older men and women: The Short Nutritional Assessment Questionnaire 65+. *Clin Nutr* 2011;31:351-8.
50. Van Aalst L. Ziektegerelateerde ondervoeding: De keuze voor één screeningsinstrument. *Nederlands Tijdschrift voor Diëtisten* 2006;61:16-9.
51. Dutch Health Care Inspectorate. Performance Indicators for Risk Steering Supervision 2007. 2006. Utrecht.
52. Health Council of the Netherlands. Malnutrition in the elderly, 2011/32. Health Council of the Netherlands. 2011. The Hague.
53. Elia M. Insights into energy requirements in disease. *Public Health Nutr* 2005;8:1037-52.
54. Shaw JH, Wildbore M, Wolfe RR. Whole body protein kinetics in severely septic patients. The response to glucose infusion and total parenteral nutrition. *Ann Surg* 1987;205:288-94.
55. Sauerwein HP, Strack van Schijndel RJ. Perspective: How to evaluate studies on peri-operative nutrition? Considerations about the definition of optimal nutrition for patients and its key role in the comparison of the results of studies on nutritional intervention. *Clin Nutr* 2007;26:154-8.
56. Sauerwein HP, Serlie MJ. Optimal nutrition and its potential effect on survival in critically ill patients. *Neth J Med* 2010;68:119-22.
57. Ishibashi N, Plank LD, Sando K, Hill GL. Optimal protein requirements during the first 2 weeks after the onset of critical illness. *Crit Care Med* 1998;26:1529-35.
58. Bauer J, Biolo G, Cederholm T et al. Evidence-based recommendations for optimal dietary protein intake in older people: a position paper from the PROT-AGE Study Group. *J Am Med Dir Assoc* 2013;14:542-59.
59. Roza AM, Shizgal HM. The Harris Benedict equation reevaluated: resting energy requirements and the body cell mass. *Am J Clin Nutr* 1984;40:168-82.
60. Weijs PJ, Kruizenga HM, van Dijk AE et al. Validation of predictive equations for resting energy expenditure in adult outpatients and inpatients. *Clin Nutr* 2008;27:150-7.
61. Borghans I, Heijink R, Kool T, Lagoe RJ, Westert GP. Benchmarking and reducing length of stay in Dutch hospitals. *BMC Health Serv Res* 2008;8:220.
62. NVZ Dutch Hospitals Association. Zorg Loont; Brancherapport algemene ziekenhuizen. 2013. Utrecht.
63. COPPA. Ligduurmonitor Nederlandse ziekenhuizen 2012. 2013. Amsterdam.
64. National Institute of Public Health and the Environment (RIVM). Trends in zorggebruik: nadere uitwerking intramurale ziekenhuiszorg. www.nationaalkompas.nl. Accessed at 22 July 2014.
65. Wilson MM, Vaswani S, Liu D, Morley JE, Miller DK. Prevalence and causes of undernutrition in medical outpatients. *Am J Med* 1998;104:56-63.
66. Neelemaat F, Kruizenga HM, de Vet HC, Seidell JC, Buttermann M, van Bokhorst-de van der Schueren MA. Screening malnutrition in hospital outpatients. Can the SNAQ malnutrition screening tool also be applied to this population? *Clin Nutr* 2008;27:439-46.



Chapter 2

Systematic screening for undernutrition in hospitals; predictive factors for success



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Abstract

Background. Since 2007, systematic screening for undernutrition has become a Performance Indicator (PI) for hospitals within the National Benchmarks on Quality of Care of the Dutch Health Care Inspectorate (HCI). Its introduction was guided by a national implementation program. The aim of this study was to evaluate the screening results from 2007 to 2010 and to identify predictive factors for achieved screening results.

Methods. All 97 Dutch hospitals were obliged to report screening results to the HCI. An additional questionnaire was developed to determine hospital characteristics, including hospital type, size, participation in implementation program, screening tool used, use of electronic records, presence of hospital-wide or ward task forces, and protocol-defined referral. Multivariate linear regression analysis was used to identify predictive factors for the obtained screening results in 2010.

Results. The mean screening percentage increased from $51\pm 28\%$ in 2007 ($n=75$ hospitals, $n=340,000$ patients) to $72\pm 17\%$ in 2010 ($n=97$; $n=1,050,000$) ($p<0.01$). Eighty-one hospitals returned the questionnaire. A higher screening percentage was associated with more clinical admissions (highest vs. lowest tertile: $\beta =14.0$, 95%CI 3.9-20.5; $p<0.01$; middle vs. lowest: $\beta =7.3$, -0.8-15.6; $p=0.05$), presence of protocol-defined referral to a dietician ($\beta =10.5$, 2.9-18.0; $p<0.01$), and use of the SNAQ screening tool (vs. MUST: $\beta =9.1$, 1.7-16.6; $p=0.02$).

Conclusion. Screening percentages have increased significantly since the introduction of the PI. Screening was more frequent in hospitals which have more patient admissions, protocol defined referral to a dietician, and who use the SNAQ screening tool. This information may assist in improving Dutch screening rates and in implementation in other countries.

Introduction

Disease related undernutrition is a major problem in healthcare settings in Western Europe and other industrialized countries. The prevalence of undernutrition in hospitals is broadly described in the literature and ranges, depending on the definition used, from 10 to 60 percent (1-10).

Undernutrition is found to be associated with reduced wound healing, increased complication rates, increased length of hospital stay, increased mortality, and increased healthcare costs (2;6;11;12). Without screening, only half of the undernourished patients are recognized by medical and nursing staff (13;14), which emphasizes the need for systematic screening (15).

In 2007, through a collaboration between the Dutch Malnutrition Steering Group (DMG) and the Dutch Ministry of Health, Welfare and Sports, systematic screening for undernutrition in hospitalized patients was introduced as a Performance Indicator (PI) within the National Benchmarks on Quality of Care of the Dutch Health Care Inspectorate (HCI). Its introduction was guided by a DMG national implementation program. Annually, hospitals are required to report on a variety of care processes to the Dutch Health Care Inspectorate. Results are used to create transparency on quality of care and to rate the performance of Dutch hospitals. The PI on undernutrition screening obliges hospitals to annually provide information on the percentage of patients screened for undernutrition at hospital admission and on prevalence of undernutrition at admission.

Our data are among the first on systematic screening of undernutrition. While many countries are working on implementation programs, nationwide mandatory nutritional screening is still rare. Moreover, little is known about factors influencing screening results. Therefore the aim of this study is to evaluate the screening results from 2007 to 2010 and to identify predictive factors for achieved undernutrition screening results.

Methods

Hospitals

All 97 Dutch hospitals (58 general, 28 teaching, 8 university and 3 specialized hospitals) were required to provide data on undernutrition screening to the HCI. Between 2006 and 2009, 57 hospitals participated in the implementation program of the Dutch Malnutrition Steering Group 'Early recognition and optimal treatment of malnutrition in Dutch hospitals'. In 4-6 multidisciplinary workshops, led by an implementation expert and a scientific expert different steps of implementation and maintenance of screening and

treatment were discussed. Moreover, a structured, multidisciplinary implementation plan was developed, and hospitals had the opportunity to share ideas. Additionally, a downloadable toolkit was developed, including implementation strategies, information material for all hospital disciplines, tools, guidelines, literature, ready to use factsheets and presentations, process evaluation forms, tools for data analysis, etc.⁽¹⁾ The other 40 hospitals implemented screening without participation in this project, but had access to all the material.

Performance Indicator on undernutrition screening

The performance indicator on undernutrition screening requires that all patients ≥ 18 years need to be screened within 24 hours after admission. Screening should be performed with a validated screening tool; either SNAQ (Short Nutritional Assessment Questionnaire) (16) or MUST (Malnutrition Universal Screening Tool) (17). A SNAQ score of 2 points or a MUST score of 1 point is defined as moderate undernutrition, and a SNAQ score ≥ 3 points or MUST score ≥ 2 points is defined as severe undernutrition. Patients are excluded for screening if they are admitted for less than 24 hours or admitted to the maternity ward (18).

The performance indicator consists of four components: the number of patients admitted to the hospital (for at least 24 hours) in the year of report, the number of patients screened at admission (within 24 hours) to hospital, the number of patients that were moderately undernourished, and the number of patients that were severely undernourished. The percentage of patients screened, and the percentages of moderately and severely undernourished patients were calculated from these numbers.

Hospitals are responsible for collecting their own data, and for reporting on the four components of the performance indicator to the HCI. Hospitals are required to provide this information on all (relevant) admissions in the year of report. Though, some hospitals provide only subsample information. Reasons for reporting subsample results are (1) screening is not implemented on all departments; (2) absence of electronic registration of undernutrition screening. Due to the time consuming character of collecting screening information manually, these latter hospitals generally use four measurements throughout the year as a sample of all admissions, as the later introduced performance indicator on undernutrition treatment involves four measurements throughout the year as well (18), or

⁽¹⁾ Dutch Malnutrition Steering Group:
www.stuurgroepondervoeding.nl (Dutch) / www.fightmalnutrition.eu (English)

use the screening information collected in one or more months as a reflection of screening throughout the year. Data on screening results from 2007-2010 were obtained directly from the Dutch Health Care Inspectorate.

Potential predictors

For this study, a questionnaire was developed to collect additional information about the hospitals. The questionnaire consisted of both closed and open ended questions, providing general hospital information and information on the implementation process. The questionnaire was tested in a pilot of 3 hospitals, including 2 general hospitals and 1 university hospital, after which minor adjustments were made. The final questionnaire was sent by email to all non-specialized hospitals, dietitians were asked to fill out and return the questionnaire. Eighty-one out of ninety-four hospitals (86%) responded to the additional questionnaire.

The following potential predictors of the obtained screening results of 2010 were investigated; hospital type (general, teaching, university, specialized), participation in the DMG implementation program (yes/no), used screening tool (SNAQ or MUST), screening information provided on all admissions or a subsample, protocol-defined referral to a dietitian in case of undernutrition (yes/no), screening implemented in an electronic nursing record (yes/no), use of an electronic dietitian record (yes/no), existence of a hospital-wide 'task force for undernutrition' (yes/no), presence of a 'task force for undernutrition' at each ward (yes/no), regular audit and feedback of screening results during the year (yes/no), target value recorded (yes/no), number of clinical admissions in 2010, number of clinical beds, number of clinical dietitians employed expressed in fulltime-equivalents (FTE) per 100 beds. The number of clinical admissions, clinical beds and FTE clinical dietitians per 100 beds were not normally distributed, and therefore divided into tertiles.

Specialized hospitals (n=3; cancer, lung, and orthopedic) were excluded from prediction analyses, as these hospitals represent patient populations that are not comparable to the other hospitals and include mostly outpatient care.

Barriers and enablers

Within the questionnaire, two open ended questions were included on barriers and enablers for optimal screening. Dietitians were required to provide factors they believed were responsible for success or failure of screening in their hospital. Two researchers (EL, HK) scored the given answers into categories of enablers and barriers. Top 10 categories

of enablers and barriers are presented. Moreover, dieticians were asked to rate the screening process in their own hospital on a 1-5 Likert scale. Scores were compared to achieved screening results.

Data analysis

Descriptive statistics were used to analyze the screening results of 2007-2010 and to summarize hospital characteristics. Means and standard deviations were calculated for continuous variables and frequency distributions were calculated for categorical variables. Analyses were performed for all hospitals (n=97) and complete cases reporting results in all years (n=75). Differences in percentages between 2007 and other years were calculated with paired-samples T-tests (n=75). Additionally, generalized estimated equations (GEE) method for longitudinal data-analyses (19) was used to analyze changes in screening percentage over time.

Characteristics of hospitals who had responded to the questionnaire and hospitals who had not responded were compared by independent samples T-tests for continuous variables and Fisher-exact tests for categorical variables.

Univariate linear regression was used to investigate the association between possible predictors of successful screening and screening percentage in 2010 as the dependent variable. Multivariate linear regression, using backward selection, was used to create a model to identify predictive factors for better screening percentages including all hospitals reporting to the questionnaire. The explained variance of the prediction model was determined by R^2 , reflecting the proportion of variance in the outcome explained by the predictors in the model.

A p-value of <0.05 was considered to be statistically significant for descriptive statistics and <0.10 was considered to be statistically significant for the linear regression analyses. Statistical analyses were performed using SPSS 20.0 for Windows (IBM Corporation, Armonk, NY, USA).

Results

Screening results

The number of hospitals that reported on the performance indicator on undernutrition screening to the Dutch Health Care Inspectorate increased from 75 in 2007 to 97 in 2010 (15 hospitals reported data on 3 years, 7 hospitals reported data on 2 years). Thereby the total number of patients reported on increased to more than one million (**Table 1**).

The average number of patients reported on per hospital (mean \pm SD) increased from $4,577 \pm 6,635$ in 2007 to $10,849 \pm 8,027$ in 2010 (paired samples T-test: $n=75$; $p<0.01$). The mean screening percentage increased significantly over the years, from $51 \pm 28\%$ in 2007 to $72 \pm 17\%$ in 2010 (GEE: $\beta=7.2$; 95%CI 5.2-9.2; $p<0.01$) (**Figure 1**). While the absolute number of identified undernourished patients has increased over the years, the percentage of moderately and severely undernourished patients decreased from respectively $7 \pm 5\%$ and $18 \pm 11\%$ in 2007 to $5 \pm 4\%$ and $15 \pm 6\%$ in 2010 (paired samples T-test: $n=75$; $p<0.01$).

In 2010, 63 hospitals (65%) reported screening data on all hospital admissions, while 34 hospitals (35%) reported data on a subsample of admissions. The screening percentage of hospitals who took a subsample was not different from hospitals reporting data on all admissions ($71 \pm 16\%$ vs. $74 \pm 18\%$; $p=0.32$). Though, the prevalence of patients identified as severely undernourished was significantly higher in hospitals presenting subsample data ($19 \pm 8\%$ vs. $13 \pm 5\%$; $p<0.01$).

Specialized hospitals ($n=3$; resp. a cancer, lung, and orthopedic center) did not report data on all years, and reported significantly lower screening results, than did the other hospitals (2010: $48 \pm 31\%$ vs. $73 \pm 16\%$; independent samples T-test: $p=0.01$). As described in the method section, these hospitals were excluded from regression analyses.

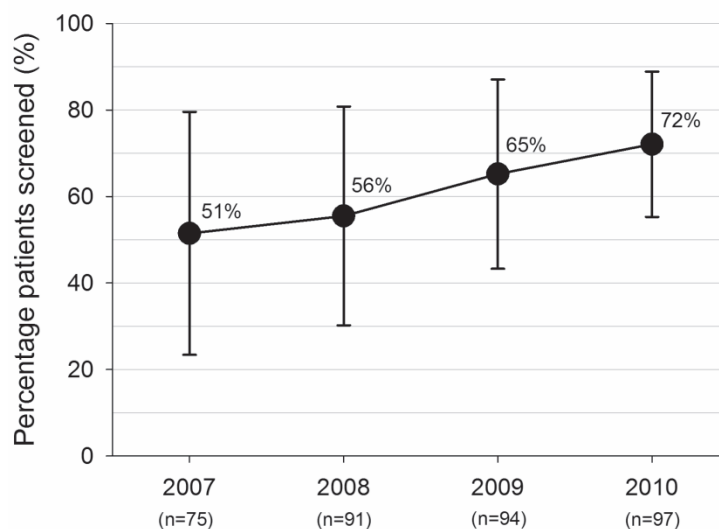


Figure 1. Screening results (%) in Dutch hospitals reported to the Dutch Health Care Inspectorate between 2007-2010 (GEE: $\beta=7.2$; 95%CI 5.2-9.2; $p<0.01$).

Table 1. Screening results 2007-2010 based on the performance indicator on undernutrition screening reported by Dutch hospitals to the Dutch Health Care Inspectorate.

	2007	2008	2009	2010
n hospitals	75	91	94	97
n patients admitted to hospital	343,241	793,901	883,065	1,052,347
mean \pm SD per hospital	4,577 \pm 6,635	8,629 \pm 8,446	9,295 \pm 7,935	10,849 \pm 8,027
min-max	80 – 27,725	46 – 37,914	79 – 37,546	81 – 38,294
paired samples T-test ^a	-	<0.01	<0.01	<0.01
n patients screened at admission	145,418	387,714	533,792	774,113
mean \pm SD per hospital	1,939 \pm 4,102	4,214 \pm 4,809	5,679 \pm 5,280	7,891 \pm 6,538
min-max	33 – 21,824	22 – 20,787	46 – 22,173	43 – 33,373
paired samples T-test ^a	-	<0.01	<0.01	<0.01
% patients screened				
mean \pm SD	51.3 \pm 27.9	55.6 \pm 25.4	64.5 \pm 22.1	72.1 \pm 16.8
min-max	(0.4-100.0)	(3.4-100.0)	(3.7-100.0)	(16.4-100.0)
paired samples T-test ^a	-	0.08	<0.01	<0.01
% moderate undernutrition ^b				
mean \pm SD	7.0 \pm 5.3	6.0 \pm 4.8	5.8 \pm 4.4	5.1 \pm 3.5
min-max	(0.5-26.3)	(0.0-28.3)	(0-24.3)	(0-21.2)
paired samples T-test ^a	-	<0.01	0.07	0.02
% severe undernutrition ^c				
mean \pm SD	18.3 \pm 10.8	17.4 \pm 8.3	16.2 \pm 7.5	15.1 \pm 7.1
min-max	(0.5-65.1)	(0.0-46.0)	(1.1-35.4)	(1.7-37.2)
paired samples T-test ^a	-	0.57	0.05	<0.01

^a paired samples T-test compared to 2007 (n=75); ^b number of hospitals reporting on (%) moderate undernutrition: 2007 n=66, 2008 n=90, 2009 n=93, 2010 n=97; ^c number of hospitals reporting on (%) severe undernutrition: 2007 n=65, 2008 n=90, 2009 n=93, 2010 n=97.

Predictive factors for screening results

Eighty-one hospitals (86%) completed the additional questionnaire. There were no statistically significant differences between characteristics of respondents compared to non-respondents with regard to screening percentage (2010: $73 \pm 14\%$ vs. $71 \pm 25\%$; $p=0.76$), hospital size ($10,716 \pm 7,850$ vs. $13,070 \pm 9,419$; $p=0.33$), hospital type (general, teaching, university: 62%, 30%, 9% vs. 62%, 31%, 8%; $p=0.99$) used screening tool (SNAQ/MUST: 81/19% vs. 77/23%; $p=0.71$) and participation in the implementation program (60% vs. 54%; $p=0.77$).

Factors associated with the screening results reported in 2010 are shown in **Table 2**. Screening results were higher for hospitals that had participated in the DMG implementation program, compared to hospitals who had implemented screening without participation in the program. Year of participation in the DMG implementation program showed no significant association with achieved screening results. Hospitals using the SNAQ undernutrition screening tool reported better screening results compared to hospitals using MUST.

Additionally, hospitals with agreements on protocol-defined referral to a dietician in case of undernutrition reported a higher screening percentage compared to hospitals without these protocols. Moreover, a higher number of clinical admissions and a higher number of clinical beds were both positively and significantly associated with screening percentage, with highest screening results for the largest hospitals (>22,000 admissions or ≥ 600 beds).

Multivariate linear regression analysis, using backward selection, provided a set of predictive factors for the obtained screening results (**Table 3**). Positive predictive factors were; being a large hospital, with >22,000 clinical admissions per year ($\beta=14.0$, 95% CI: 3.9–20.5, $p<0.01$) or 12,500–22,000 admissions per year ($\beta=7.3$, 95% CI: -0.8–15.6, $p=0.05$), having a protocol-defined referral to a dietician in case of undernutrition ($\beta=10.5$, 95%CI: 2.9–18.0; $p<0.01$), screening with SNAQ ($\beta=9.1$, 95%CI: 1.7–16.6; $p=0.02$). The proportion of variance in outcome explained by the predictors in the model (R^2) was 0.25.

Table 2. Univariate predictors of screening results in 2010.

		n	(%)	β^a	95% CI
<i>General information (n=94)</i>					
Hospital type	General hospitals ^b	58	(62)	-	-
	Teaching hospitals	28	(30)	5.1	-2.1 ; 12.2
	University hospitals	8	(9)	-8.0	-19.7 ; 3.7
Participation in DMG implementation program	Yes	56	(60)	6.4	-0.2 ; 12.9**
	No ^b	38	(40)	-	-
Year of participation in DMG implementation program (n=56)	2006 ^b	6	(11)	-	-
	2007	29	(52)	-5.7	-17.4 ; 6.1
	2008	15	(27)	-7.5	-20.2 ; 5.1
	2009	6	(11)	7.6	-7.5 ; 22.7
<i>Information provided by HCI (n=94)</i>					
Undernutrition screening tool	SNAQ	76	(81)	7.0	-1.1 ; 15.2**
	MUST ^b	18	(19)	-	-
Year of first report on screening indicator to HCI	2007 ^b	75	(79)	-	-
	2008	15	(16)	-4.0	-12.9 ; 5.0
	2009	4	(4)	-4.5	-20.7 ; 11.8
Type of measurement 2010	All admissions	60	(64)	-2.5	-9.2 ; 4.3
	Subsample ^b	34	(36)	-	-
<i>Questionnaire (n=81)</i>					
Protocol-defined referral to a dietician	Yes	68	(84)	10.5	2.3 ; 16.7*
	No ^b	13	(16)	-	-
Screening incorporated in electronic nursing record	Yes	27	(33)	-2.4	-9.0 ; 4.2
	No ^b	54	(67)	-	-
Electronic dietician record	Yes	24	(30)	0.3	-6.5 ; 7.2
	No ^b	57	(70)	-	-
Hospital-wide task force	Yes	40	(49)	-0.9	-7.1 ; 5.4
	No ^b	41	(51)	-	-
Task force on each ward	Yes	27	(33)	-3.3	-9.9 ; 3.3
	No ^b	54	(67)	-	-
Evaluation of screening percentage during the year	Yes	68	(84)	5.6	-2.8 ; 14.0
	No ^b	13	(16)	-	-
Target value recorded	Yes	48	(59)	1.1	-5.3 ; 7.4
	No ^b	33	(41)	-	-

Table 2. Continued.

		n	(%)	β^a	95% CI
Number of clinical admissions in 2010 ^c	Low (<12,500) ^b	23	(28)	-	-
	Middle (12,500-22,000)	26	(32)	7.1	-0.6 ; 14.8**
	High (>22,000)	25	(31)	11.9	4.2 ; 19.7*
	Missing	7	(9)	6.3	-5.3 ; 17.9
Number of clinical beds in 2010 ^d	Low (≤ 300) ^b	24	(30)	-	-
	Middle (301-599)	28	(35)	6.4	-1.4 ; 14.1
	High (≥ 600)	27	(33)	8.4	0.8 ; 16.1*
FTE clinical dieticians (per 100 clinical beds)	Low (<0.8) ^b	21	(26)	-	-
	Middle (0.8-1.2)	29	(36)	-0.2	-8.4 ; 7.9
	High (>1.2)	22	(27)	2.0	-6.7 ; 10.6
	Missing	9	(11)	-0.8	-12.1 ; 10.6

DMG, Dutch Malnutrition Steering Group; HCI, Health Care Inspectorate

^a β =regression coefficient; ^b reference category; ^c number of clinical admissions according to the questionnaire; ^d 2 missing values (n=79).* $p < 0.05$; ** $p < 0.10$.**Table 3.** Multivariate predictors of screening results in 2010 (n=81).

		n	(%)	β^a	95% CI	p-value
Constant		49.6		32.3 ; 60.0		
Number of clinical admissions in 2010	Low (<12,500) ^b	23	(28)	-	-	
	Middle (12,500-22,000)	26	(32)	7.3	-0.8 ; 15.6	0.05
	High (>22,000)	25	(31)	14.0	3.9 ; 20.5	<0.01
	Missing	7	(9)	7.9	-3.0 ; 18.7	0.15
Protocol-defined referral to a dietician	Yes	68	(84)	10.5	2.9 ; 18.0	<0.01
	No ^b	13	(16)	-	-	
Undernutrition screening tool	SNAQ	66	(82)	9.1	1.7 ; 16.6	0.02
	MUST ^b	15	(19)	-	-	

^a β =regression coefficient; ^b reference category.

Subjectively reported barriers and enablers

Self-rating of screening by dietitians (Likert scale 1-5) was strongly related to screening results ($\beta=5.5$; 95%CI: 2.4-8.5; $p<0.01$). Most reported enablers for successful screening were engagement of nurses and specialists, screening as an obligated item in (electronic) patient record, and continuous motivation and education by dietitians. Most reported barriers were high workload, absence of engagement/support of nurses and specialists, and absence of clear multidisciplinary responsibility (**Table 4**).

Table 4. Subjectively reported enablers and barriers for optimal screening by dietitians (n=81)

Enablers		n (%) ^a
1	engagement of nurses/specialists	28 (36%)
2	screening as a required item in (electronic) record	27 (35%)
3	continuous motivation and education by dietitians	27 (35%)
4	clear multidisciplinary responsibility	21 (27%)
5	coordination by hospital management	18 (23%)
6	frequent feedback and support of screening results	15 (19%)
7	simple quick-and-easy screening	6 (8%)
8	obligating character of the performance-indicator	6 (8%)
9	well-structured task force on each ward	4 (5%)
10	sufficient resources (computers, ICT support)	3 (4%)
Barriers		n (%) ^b
1	high workload	25 (34%)
2	lack of engagement of nurses/specialists	20 (27%)
3	lack of clear multidisciplinary responsibility	17 (23%)
4	absence of good ICT support or (non-optimal) electronic patient record	15 (21%)
5	insufficient coordination by hospital management	11 (15%)
6	screening too time-consuming	10 (14%)
7	communication problems, insufficient education	10 (14%)
8	prevalence related factors (short admissions, low prevalence of undernutrition in certain wards)	10 (14%)
9	organizational restructuring	6 (8%)
10	absence of good feedback of screening results	5 (7%)

^a n=78; 3 dietitians reported no enablers for optimal screening; ^b n=73; 8 dietitians reported no barriers for optimal screening.

Discussion

Our data are among the first on nationwide mandatory systematic screening of undernutrition in hospitals, and therefore present unique information, based on data of all Dutch hospitals with more than 1 million admissions per year. The percentage of patients screened within 24 hours after hospital admission increased significantly over the years 2007-2010, from 51 to 72%, whereas the percentage of patients identified as severely undernourished decreased from 18 to 15%.

This study also gives insight into factors associated with higher reported screening percentage: a higher number of clinical admissions, having agreements on protocol-defined referral to a dietician in case of undernutrition and screening with SNAQ.

Hospitals with more clinical admissions reported 7 to 14% higher screening percentages compared to hospitals with the least clinical admissions. It is suggested that smaller hospitals have less clinical dieticians employed. Continuous motivation and education by dieticians was reported by one third of the respondents as an enabler for successful screening. We expect that larger teams of clinical dieticians have more possibilities and resources to motivate and educate care workers. Moreover, larger hospitals might be involved in other implementation programs, and have better policy on implementation strategies.

Hospitals with protocol-defined referral reported an 11% higher screening percentage than hospitals without protocol-defined referral. Screening for undernutrition is generally carried out by nurses. If referral to a dietician is defined by protocol, the nurse is allowed to refer the undernourished patient to the dietician, without interference of a physician, and treatment can be started at an earlier stage. Although screening takes place before the referral, a protocol-defined referral may reflect a good structure around undernutrition, where agreements are made on early recognition and optimal treatment of the undernourished patient. A study of the Scandinavian Nutrition Group demonstrated that when there were more guidelines for parenteral and enteral nutrition in hospitals, there was a positive change towards implementation of good nutrition standards (20). Thus, it is likely that by shifting these responsibilities from physicians to nursing staff, nurses will become more involved in the process of treatment, which may result in more engagement, and thereby a better screening result. Lack of engagement of nursing staff was also addressed as a barrier for successful screening by one third of the dieticians.

Type of screening tool was associated with percentage patients screened. Hospitals screening for undernutrition with SNAQ reported a 9% higher mean screening percentage than hospitals screening with MUST. SNAQ is a quick-and-easy method whereas MUST involves calculation of BMI (kg/m^2) and percentage weight loss. Van Venrooij et al., in an

earlier study, also suggested that the calculation of percentage weight loss or BMI are too time consuming for routine use in clinical practice (21). Another study comparing undernutrition screening tools showed that SNAQ provided more complete data than MUST (22). These studies support our finding that a quick-and-easy screening tool may enhance screening in a clinical setting.

Approximately one-quarter of the observed variance in the 2010 screening rates could be explained for by the combination of the number of clinical admissions, protocol-defined referral to a dietician, and the used screening tool. Other variance might be explained by factors such as lack of nutritional knowledge, interest and education of health care workers, lack of clearly defined responsibilities of planning and managing nutritional care, and the high workload of nurses, which have been extensively studied by the Scandinavian Nutrition Group (4;20;23-25). This is supported by the results of the collected data on enablers and barriers for optimal screening. Most reported barriers were high workload (34%), lack of engagement of nurses and specialists (27%), and lack of clear multidisciplinary responsibilities (23%). These factors should be addressed in order to improve both nutritional screening and treatment in hospitalized patients.

The hospital data of 2010 showed that 15% of the screened patients were identified as severely undernourished. This is in line with studies done in Western Europe regarding the prevalence of undernutrition (3;4;6;10;26). Over the years, the data showed a decline in the reported prevalence of undernutrition. Meijers et al. also described a decline in prevalence of undernutrition in hospitals involved in the annual LPZ measurement between 2004 and 2007 especially in those hospitals involved in the measurement more often (27). Furthermore, O'Flynn et al. demonstrated that the prevalence of hospital undernutrition declined from 24% in 1998 to 19% in 2004 in 3 consecutive studies as a result of implementation of nutritional strategies and nutritional screening (28). Both studies address the effect of increased knowledge and awareness of undernutrition in medical staff. This also thoroughly applies to our results, showing that hospitals involved in our carefully supervised nationwide 1-year implementation program for screening and treatment of undernutrition in hospitalized patients report higher levels of screening. Moreover, we believe that with increasing attention for undernutrition in the clinical setting, awareness of this problem in the hospital outpatient setting increased as well. In fact, during this study period, several hospitals implemented undernutrition screening in some of their outpatient departments. Recognition and treatment of undernourished patients in the outpatient setting, may contribute to a higher number of patients in a better nutritional status at hospital admission, or hospital admissions may even be postponed or prevented. Due to declining length of hospital stay, a shift toward

outpatient screening is inevitable. As of 2013, undernutrition screening in the preoperative outpatient department is advised by the HCI (18).

A major strength of our data is the magnitude of the sample size. Due to the mandatory character of the PI, all Dutch hospitals are involved, so results could not have been biased because only the most motivated hospitals have participated. Furthermore, the response rate to the questionnaire was high (86%) and no differences were observed between respondents and non-respondents. The reported data include over hundred thousands of patients per year, and even more than one million patients in 2010. However, data on screening is collected at hospital-level, not at patient-level. Out of the 1,052,347 newly admitted patients in 2010, 774,113 patients were screened on admission. This means that 73.6% of the total of admitted patients to all hospitals were screened within 24 hours after admission, while the average screening percentage per hospitals is 72.1%. A recommendation for further research is to assess predictive factors for successful screening results on patient-level, so that patient-related factors can be included.

A limitation of the study is the fact that hospitals were responsible for reporting screening data themselves. As a result, both overestimation (4 hospitals reported a screening percentage of 100% in 2010) and underestimation (2 hospitals reported below 20% screening in 2010) are expected.

Another disadvantage of the data collected by hospitals is that, while hospitals are obliged to report on all admitted patients, one third of hospitals reported only subsample results. In the first years, subsample results represented data on a selection of departments, as in most hospitals undernutrition screening was not implemented throughout all departments. Since most hospitals started to screen in the patients groups most vulnerable for undernutrition, these data are likely to represent the departments with a higher risk of undernutrition. In 2010, subsample results were mostly based on four measurements throughout the year, and are more likely to be a proper indication of screening in all departments. The reported screening percentage for those hospitals was not significantly different from hospitals reporting on all admissions. Though, the reported prevalence of severe undernutrition was significantly higher in hospitals reporting subsample results, still suggesting that more high-risk departments were involved in the measurements. This could have biased the reported decrease in prevalence of undernutrition. Hospitals increasingly introduce electronic patient records, so collecting data on screening of hospitalized patients will be easier. Future measurements are therefore expected to be more complete and accurate.

Conclusion

The Dutch approach to undernutrition is unique. Hospitals are required to report on the performance indicator on undernutrition screening, and these data are monitored by the Dutch Health Care Inspectorate. This mandatory screening guided by a national implementation program, seems to be a successful approach to increase screening and decrease undernutrition prevalence rates. Higher screening results are associated with total number of clinical admissions, the availability of a protocol defined referral and the type of screening tool used. Based on these results, we advise hospitals to use a quick-and-easy screening tool for undernutrition screening, and to embed undernutrition screening in a structured, multidisciplinary implementation plan, including protocol-defined referral. This information is crucial to further improve Dutch screening results, and may be valuable for implementation of undernutrition screening in other countries.

References

1. Agarwal E, Ferguson M, Banks M et al. Nutrition care practices in hospital wards: results from the Nutrition Care Day Survey 2010. *Clin Nutr* 2012;31:995-1001.
2. Correia MI, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. *Clin Nutr* 2003;22:235-9.
3. Edington J, Boorman J, Durrant ER et al. Prevalence of malnutrition on admission to four hospitals in England. The Malnutrition Prevalence Group. *Clin Nutr* 2000;19:191-5.
4. Kondrup J, Johansen N, Plum LM et al. Incidence of nutritional risk and causes of inadequate nutritional care in hospitals. *Clin Nutr* 2002;21:461-8.
5. Meijers JM, Schols JM, van Bokhorst-de van der Schueren MA, Dassen T, Janssen MA, Halfens RJ. Malnutrition prevalence in The Netherlands: results of the annual dutch national prevalence measurement of care problems. *Br J Nutr* 2009;101:417-23.
6. Norman K, Pichard C, Lochs H, Pirlich M. Prognostic impact of disease-related malnutrition. *Clin Nutr* 2008;27:5-15.
7. Pirlich M, Schutz T, Norman K et al. The German hospital malnutrition study. *Clin Nutr* 2006;25:563-72.
8. Rasmussen HH, Kondrup J, Staun M, Ladefoged K, Kristensen H, Wengler A. Prevalence of patients at nutritional risk in Danish hospitals. *Clin Nutr* 2004;23:1009-15.
9. Stratton RJ, Green CJ, Elia M. Disease related malnutrition: an evidence-based approach to treatment. 1 ed. Cambridge: CABI Publishing 2003:1-34.
10. Tannen A, Lohrmann C. Malnutrition in Austrian hospital patients. Prevalence, risk factors, nursing interventions, and quality indicators: a descriptive multicentre study. *J Adv Nurs* 2012.
11. Naber TH, Schermer T, de BA et al. Prevalence of malnutrition in nonsurgical hospitalized patients and its association with disease complications. *Am J Clin Nutr* 1997;66:1232-9.
12. Agarwal E, Ferguson M, Banks M et al. Malnutrition and poor food intake are associated with prolonged hospital stay, frequent readmissions, and greater in-hospital mortality: Results from the Nutrition Care Day Survey 2010. *Clin Nutr* 2012.
13. Bavelaar JW, Otter CD, van Bodegraven AA, Thijs A, van Bokhorst-de van der Schueren MA. Diagnosis and treatment of (disease-related) in-hospital malnutrition: the performance of medical and nursing staff. *Clin Nutr* 2008;27:431-8.
14. Kruijenga HM, Wierdsma NJ, van Bokhorst-de van der Schueren MA et al. Screening of nutritional status in The Netherlands. *Clin Nutr* 2003;22:147-52.
15. Elia M, Zellipour L, Stratton RJ. To screen or not to screen for adult malnutrition? *Clin Nutr* 2005;24:867-84.
16. Kruijenga HM, Seidell JC, de Vet HC, Wierdsma NJ, van Bokhorst-de van der Schueren MA. Development and validation of a hospital screening tool for malnutrition: the short nutritional assessment questionnaire (SNAQ). *Clin Nutr* 2005;24:75-82.

17. Stratton RJ, Hackston A, Longmore D et al. Malnutrition in hospital outpatients and inpatients: prevalence, concurrent validity and ease of use of the 'malnutrition universal screening tool' ('MUST') for adults. *Br J Nutr* 2004;92:799-808.
18. Dutch Health Care Inspectorate. Performance Indicators for Risk Steering Supervision 2013. Utrecht; 2012.
19. Twisk JW. Longitudinal data analysis. A comparison between generalized estimating equations and random coefficient analysis. *Eur J Epidemiol* 2004;19:769-76.
20. Lindorff-Larsen K, Hojgaard RH, Kondrup J, Staun M, Ladefoged K. Management and perception of hospital undernutrition-a positive change among Danish doctors and nurses. *Clin Nutr* 2007;26:371-8.
21. Van Venrooij LMW, De Vos R, Borgmeijer-Hoelen AMMJ, Kruizenga HM, Jonkers-Schuitema CF, DE Mol BMAJ. Quick-and-easy screening tool to detect disease-related undernutrition in a hospital in- and out-patient setting: a systematic review. *e-SPEN, the European e-Journal of Clinical Nutrition and Metabolism* 2007;2007:21-37.
22. Neelemaat F, Meijers J, Kruizenga H, van BH, van Bokhorst- de van der Schueren MAE. Comparison of five malnutrition screening tools in one hospital inpatient sample. *J Clin Nurs* 2011;20:2144-52.
23. Johansson U, Rasmussen HH, Mowe M, Staun M. Clinical nutrition in medical gastroenterology: room for improvement. *Clin Nutr* 2009;28:129-33.
24. Mowe M, Bosaeus I, Rasmussen HH, Kondrup J, Unosson M, Irtun O. Nutritional routines and attitudes among doctors and nurses in Scandinavia: a questionnaire based survey. *Clin Nutr* 2006;25:524-32.
25. Mowe M, Bosaeus I, Rasmussen HH et al. Insufficient nutritional knowledge among health care workers? *Clin Nutr* 2008;27:196-202.
26. Kelly IE, Tessier S, Cahill A et al. Still hungry in hospital: identifying malnutrition in acute hospital admissions. *QJM* 2000;93:93-8.
27. Meijers JM, Candel MJ, Schols JM, van Bokhorst-de van der Schueren MA, Halfens RJ. Decreasing trends in malnutrition prevalence rates explained by regular audits and feedback. *J Nutr* 2009;139:1381-6.
28. O'Flynn J, Peake H, Hickson M, Foster D, Frost G. The prevalence of malnutrition in hospitals can be reduced: results from three consecutive cross-sectional studies. *Clin Nutr* 2005;24:1078-88.



Chapter 3

Predictors for achieving protein and energy requirements in undernourished hospital patients



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Abstract

Background. Providing sufficient protein and energy is considered crucial in the treatment of undernutrition. Still, the majority of undernourished hospital patients have a suboptimal protein and energy intake. The aim of this study was to investigate predictors for achieving protein and energy requirements on the fourth day of admission in undernourished hospitalized patients.

Methods. 830 adult undernourished patients (SNAQ ≥ 3) were retrospectively included. Intake requirements were defined as ≥ 1.2 g protein per kg body weight and $\geq 100\%$ of the energy requirement based on calculated resting energy expenditure according to Harris & Benedict + 30%. Logistic regression analyses were performed to investigate predictors for achieving the requirements.

Results. Protein and energy intake had been recorded for 610 patients, of whom 25.6% had sufficient protein and energy intake. Protein requirements were less commonly met than energy requirements. Complete case analyses ($n=575$) showed that negative predictors for achieving the protein and energy requirements were: nausea (OR=0.18; 95%CI=0.06-0.53), cancer (0.57; 0.35-0.93), acute infections (0.63; 0.37-1.01) and higher BMI (0.84; 0.79-0.89). Positive predictors were: a higher age (1.01; 1.00-1.03), chronic lung disease (3.76; 2.33-6.07) and receiving tube feeding (3.89; 1.56-9.73).

Conclusion. Only one in four undernourished hospital patients meets the predefined protein and energy requirements on the fourth day of admission. Nausea, cancer, acute infections, BMI, age, chronic lung disease and tube feeding were identified as predictors for achieving protein and energy intake.

Introduction

Disease related undernutrition is a common problem in hospitalized patients, with a prevalence rating between 25 and 40% (1-7). Causes for disease related undernutrition are reduced intake, changes in metabolism, or abnormal losses due to malabsorption, leading to a deficiency or imbalance of protein, energy and other nutrients (6;8). Undernutrition is associated with increased morbidity and mortality in acute and chronic diseases, impairment of recovery, prolonged length of stay, and increased treatment costs (6;9;10).

The standard treatment of undernutrition is aimed at achieving optimal protein and energy intake, according to a patient's requirements, in order to reduce the effects of catabolism and minimize the loss of body protein mass (11). The adequate level of protein intake for hospitalized patients is currently defined as 1.2-1.7 gram per kilogram bodyweight per day (11-13). The adequate level of energy intake is generally assessed by using the estimated resting energy expenditure (REE) of Harris and Benedict (14) with an additional factor of 30% for either activity or disease (11;15).

Data on nutritional intake of undernourished patients are scarce. A study of Dupertuis et al. (2003) showed that 43% of hospitalized patients, independent of nutritional status, did not achieve their minimal protein and energy needs (defined as 0.8 g per kg bodyweight per day and Harris & Benedict (16)) and that 70% did not reach their recommended needs (defined as 1.2 or 1.0 g/kg day (for patients \leq or $>$ 65 years) and Harris & Benedict (16) + 10%) (17). First results of the multinational NutritionDay survey showed that 60% of all patients admitted to the hospital did not eat their full regular meals on the measurement day, and that these patients were considered to be at increased risk of acquiring a significant protein-energy deficit within a few days (18).

It is still unknown which factors influence the chance of sufficient protein and energy intake. Therefore, the objective of this study was to investigate predictors for achieving protein and energy requirements in undernourished hospital patients.

Materials and Methods

Subjects

This study was conducted in the Franciscus Hospital, a general hospital in Roosendaal, The Netherlands. At admission to the hospital, patients were routinely screened with the Short Nutritional Assessment Questionnaire (SNAQ) (19). All patients admitted to the hospital in 2008 who were screened as undernourished (SNAQ score \geq 3) at hospital admission were

retrospectively included in this study. Patients below the age of 18 years or with a hospital stay of less than four days were excluded.

Data collection

Data was retrospectively derived from the dietetic registration records and represents routine care. Data on protein and energy intake was collected using a structured intake list filled in by an educated nutrition assistant or a trained nurse. When a patient had consumed anything in addition to the hospital menu this was documented precisely by the nutrition assistant. Daily intake was calculated by a dietician and was recorded in the dietetic registration record and discussed with the patient. Protein and energy intakes were calculated, respectively in grams and kilocalories based on the NEVO Dutch Food Consumption Table 2006 (20) and the Directives for Sizes and Weights (21). The intake list was recorded on both the third and fourth day of hospital admission to check for inconsistencies. In case of uncertainty about a patient's intake, the dietician always contacted the patient and the nutritional assistant for further intake analyses. The calculated intake on the fourth day was used in these analyses. If this was missing, the reported intake on the third day of admission was used (n=20). Other general and medical information, anthropometric data and information on additional nutrition during the first days of hospital stay was obtained from either electronic or written hospital records, by using a structured case record form.

This study was approved by the ethical review board of the VU University Medical Center. Because all Dutch hospitals annually have to report on the number of undernourished patients who were optimally treated to the Dutch Health Care Inspectorate, data on intake were already collected. Data were coded and stored anonymously.

Criteria for sufficient protein and energy intake

The criteria for sufficient protein and energy intake were based on the most commonly used requirements for protein and energy. In The Netherlands, optimal protein intake is currently defined as 1.2–1.7 gram per kilogram bodyweight per day (11-13). The cut-off point for sufficient protein intake was set at at least 1.2 g/kg as described by the performance indicator defined by the Dutch Health Care Inspectorate (22). For obese patients, protein requirements were adjusted to a BMI of 27, as recommended in the Dutch perioperative guidelines (22;23). Energy requirements were based on the estimated resting energy expenditure (REE) of Harris and Benedict (14) plus an additional factor of

30% to correct for activity and/or disease (11;15;23). An intake of 100% or more of this requirement was defined as sufficient.

Patient related factors

To obtain insight into reasons for reaching sufficient intake, we studied patient related factors that possibly influence protein and energy intake. Next to general patient characteristics (age, gender) we included anthropometric data (bodyweight (kg), height (cm), and BMI (kg/m^2)). Furthermore, patients' underlying diseases were registered (cancer, gastrointestinal diseases, chronic lung diseases, kidney diseases, nervous disorders, psychological disorders, acute infections or other diseases) (24-27). In addition, data was collected on factors influencing nutritional intake, i.e. chemotherapy, surgery, nausea, diarrhea and swallowing problems during the first four days of admission. Moreover, data on the use of sip feeding, tube feeding and parenteral nutrition during the first four days of admission was recorded. Finally we recorded absolute SNAQ score, hypothesizing that a higher SNAQ score would reflect a more complex patient (28).

Statistical analyses

Descriptive statistics were used to analyze patient characteristics. Characteristics of the patients with known and missing data on protein and energy intake were compared by chi-square tests for categorical variables and Student's t-tests for continuous variables. Percentages of patients who achieved the requirements on the fourth day of admission were calculated.

Further analyses were performed with patients having complete data on protein and energy intake as well as possible predictors. Differences between those who met and those who did not meet the protein and energy requirements were compared by chi-square tests (categorical variables) and Student's t-tests (continuous variables). To identify predictors for achieving adequate protein and energy intake, a prediction model was made with optimal protein and energy intake as dependent variable, using multivariate backward logistic regression analysis. The diagnostic accuracy of the prediction model was assessed in a ROC curve, whereby the area under the curve (AUC) shows the predicted probability of the model. A *p*-value of <0.05 was considered to be statistically significant for descriptive statistics and <0.10 was considered to be statistically significant for the logistic regression analyses. Data were analyzed using SPSS version 15.0 for Windows.

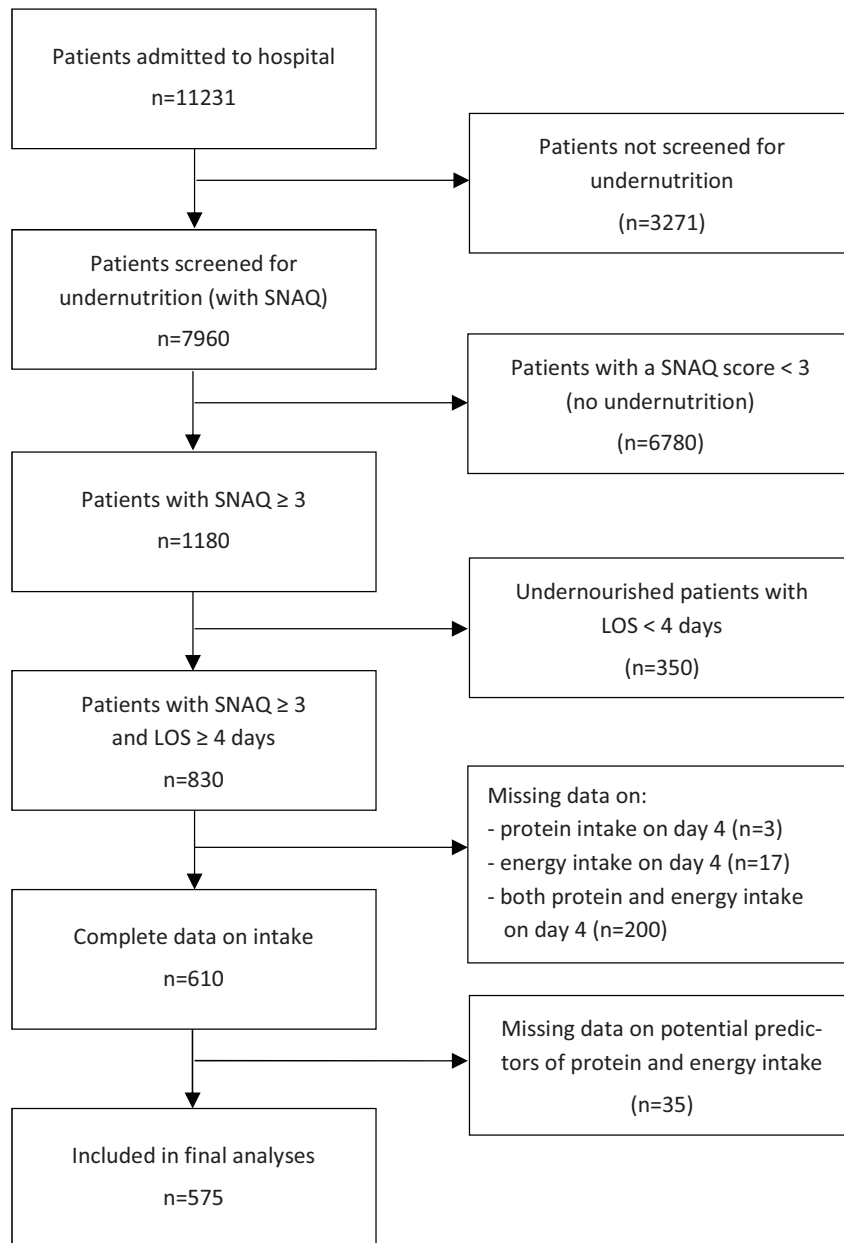


Figure 1. Flowchart.

Results

Patient characteristics

In 2008, 7960 (71%) of all 11231 patients admitted to the Franciscus Hospital were screened with the SNAQ. A total of 1180 (15%) were found to be undernourished. Of these, 830 patients with a hospital stay of four days or more were included in the study. Mean age was 69.0 (\pm 14.4) years and 50% of the patients were male. Of all patients, 320 (38.6%) had a malignant disease, 215 (25.9%) had an acute infection, and 161 (19.4%) had a chronic lung disease (primarily COPD). Older patients (\geq 65 years) more often had multiple diseases than did younger patients (39.7% vs. 23.7%; $p < 0.001$).

Protein and energy intake had been reported for 610 (73.5%) out of 830 patients (**Figure 1**). Comparing patients with complete data on protein and energy intake to patients with missing data, we observed that patients with a known intake were more likely to have a chronic lung disease (21.5% vs. 13.6%, $p = 0.012$), and were less likely to have psychological disorders (3.8% vs. 7.3%; $p = 0.035$), acute infections (24.1% vs. 30.9%, $p = 0.048$), or to use sip feeding (28.5% vs. 38.6%, $p = 0.060$). Only one patient received parenteral nutrition, therefore this parameter was not used in the analyses.

Protein and energy intake

Energy requirements were met significantly more often than protein requirements ($p < 0.001$). Of the 610 patients with known intake, 156 patients (25.6%) had both sufficient protein and energy intake on the fourth day of admission, 16 patients (2.6%) had sufficient protein intake only and 82 patients (13.4%) had sufficient energy intake only (**Figure 2**). More than half of the patients (58.4%) did not meet the predefined requirements for either protein or energy. Of all patients who met the protein requirements ($n = 172$), 90.7% also met the energy requirements, and of those who met the energy requirements ($n = 238$), 65.5% also met the protein requirements.

For 575 patients both protein and energy intake, as well as all possible predictors were reported. In **Table 1**, patient characteristics of the undernourished patients are shown for both protein and energy requirements achieved, as well as protein requirements achieved, and energy requirements achieved. Patients using sip feeding or tube feeding and those with chronic lung diseases achieved the protein and energy requirements more often. Patients with higher BMI, younger age, cancer, patients experiencing nausea and patients undergoing surgery reached the requirements less often. Similar associations were found when looking solely at achieving the protein requirements or achieving the energy requirements.

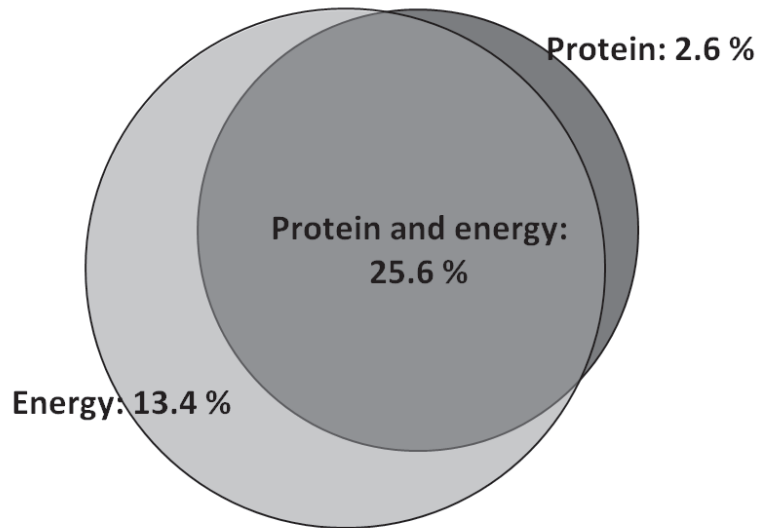


Figure 2. Percentage of undernourished patients with adequate protein and/or energy intake.

Predictors for achieving protein and energy requirements

Backward logistic regression analysis provided predictors for achieving the protein and energy requirements (**Table 2**). Negative predictors for achieving the protein and energy requirements were: nausea (OR=0.18; 95%CI=0.06-0.53), cancer (0.57; 0.35-0.93), acute infection (0.63; 0.37-1.01) and having a higher BMI (0.84 per point BMI (kg/m^2); 0.79-0.89). Having a higher age (1.01 per year; 1.00-1.03), having a chronic lung disease (3.76; 2.33-6.07) and receiving tube feeding (3.89; 1.56-9.73) were found to be positive predictors for achieving the nutritional requirements. Sip feeding was significantly related to achieving the requirements in the univariate chi-square tests, but did not reach statistical significance in the prediction model.

The ROC curve for this prediction model showed an AUC of 0.791 (0.749-0.832; $p < 0.001$), indicating that achieving the protein and energy requirements at day 4 can be moderately explained by this model.

Table 1. Characteristics of undernourished hospital patients by protein and/or energy intake.

	All				Both protein and energy				Only protein				Only energy			
	insufficient		sufficient ^c		insufficient		sufficient ^c		insufficient		sufficient ^c		insufficient		sufficient ^c	
N patients	575	430	145	161	414	161	225	350	225	350	225	350	225	350	225	350
Sex, male ^a	282 (49.0%)	215 (50.0%)	67 (46.2%)	0.429	209 (50.5%)	73 (45.3%)	0.268	174 (49.7%)	108 (48.0%)	174 (49.7%)	108 (48.0%)	174 (49.7%)	108 (48.0%)	174 (49.7%)	108 (48.0%)	174 (49.7%)
Age ^b	68.9 ± 14.3	68.2 ± 14.7	71.1 ± 12.9	0.037	68.5 ± 14.5	70.2 ± 13.7	0.197	67.1 ± 14.9	71.8 ± 12.8	67.1 ± 14.9	71.8 ± 12.8	67.1 ± 14.9	71.8 ± 12.8	67.1 ± 14.9	71.8 ± 12.8	67.1 ± 14.9
Age ≥ 65 years ^a	380 (66.1%)	278 (64.7%)	102 (70.3%)	0.210	271 (65.5%)	109 (67.7%)	0.610	216 (61.7%)	164 (72.9%)	216 (61.7%)	164 (72.9%)	216 (61.7%)	164 (72.9%)	216 (61.7%)	164 (72.9%)	216 (61.7%)
SNAQ score ≥ 5 ^a	231 (40.2%)	171 (39.8%)	60 (41.4%)	0.732	165 (39.9%)	66 (41.0%)	0.803	142 (40.6%)	89 (39.6%)	142 (40.6%)	89 (39.6%)	142 (40.6%)	89 (39.6%)	142 (40.6%)	89 (39.6%)	142 (40.6%)
BMI (kg/m ²) ^b	23.4 ± 4.5	24.1 ± 4.5	21.3 ± 3.8	<0.001	24.2 ± 4.4	21.4 ± 3.9	<0.001	24.3 ± 4.7	22.0 ± 3.8	24.3 ± 4.7	22.0 ± 3.8	24.3 ± 4.7	22.0 ± 3.8	24.3 ± 4.7	22.0 ± 3.8	24.3 ± 4.7
BMI < 18.5 ^a	60 (10.4%)	32 (7.4%)	28 (19.3%)	<0.001	29 (7.0%)	31 (19.3%)	<0.001	26 (7.4%)	34 (15.1%)	26 (7.4%)	34 (15.1%)	26 (7.4%)	34 (15.1%)	26 (7.4%)	34 (15.1%)	26 (7.4%)
BMI ≥ 25 ^a	177 (30.8%)	158 (36.7%)	19 (13.1%)	<0.001	156 (37.7%)	21 (13.0%)	<0.001	135 (38.6%)	42 (18.7%)	135 (38.6%)	42 (18.7%)	135 (38.6%)	42 (18.7%)	135 (38.6%)	42 (18.7%)	135 (38.6%)
BMI ≥ 30 ^a	43 (7.5%)	41 (9.5%)	2 (1.4%)	0.001	39 (9.4%)	4 (2.5%)	0.005	37 (10.6%)	6 (2.7%)	37 (10.6%)	6 (2.7%)	37 (10.6%)	6 (2.7%)	37 (10.6%)	6 (2.7%)	37 (10.6%)
Cancer ^a	215 (37.4%)	179 (41.6%)	36 (24.8%)	<0.001	173 (41.8%)	42 (26.1%)	<0.001	156 (44.6%)	59 (26.2%)	156 (44.6%)	59 (26.2%)	156 (44.6%)	59 (26.2%)	156 (44.6%)	59 (26.2%)	156 (44.6%)
Gastrointestinal disease ^a	50 (8.7%)	36 (8.4%)	14 (9.7%)	0.635	35 (8.5%)	15 (9.3%)	0.742	30 (8.6%)	20 (8.9%)	30 (8.6%)	20 (8.9%)	30 (8.6%)	20 (8.9%)	30 (8.6%)	20 (8.9%)	30 (8.6%)
Chronic lung disease ^a	126 (21.9%)	63 (14.7%)	63 (43.4%)	<0.001	60 (14.5%)	66 (41.0%)	<0.001	48 (13.7%)	78 (34.7%)	48 (13.7%)	78 (34.7%)	48 (13.7%)	78 (34.7%)	48 (13.7%)	78 (34.7%)	48 (13.7%)
Kidney disease ^a	21 (3.7%)	17 (4.0%)	4 (2.8%)	0.507	16 (3.9%)	5 (3.1%)	0.563	9 (2.6%)	12 (5.3%)	9 (2.6%)	12 (5.3%)	9 (2.6%)	12 (5.3%)	9 (2.6%)	12 (5.3%)	9 (2.6%)
Nervous disorder ^a	52 (9.0%)	39 (9.1%)	13 (9.0%)	0.970	38 (9.2%)	14 (8.7%)	0.856	29 (8.3%)	23 (10.2%)	29 (8.3%)	23 (10.2%)	29 (8.3%)	23 (10.2%)	29 (8.3%)	23 (10.2%)	29 (8.3%)
Psychological disorder ^a	22 (3.8%)	15 (3.5%)	7 (4.8%)	0.467	15 (3.6%)	7 (4.3%)	0.684	13 (3.7%)	9 (4.0%)	13 (3.7%)	9 (4.0%)	13 (3.7%)	9 (4.0%)	13 (3.7%)	9 (4.0%)	13 (3.7%)
Acute infection ^a	137 (23.8%)	110 (25.6%)	27 (18.6%)	0.089	107 (25.8%)	30 (18.6%)	0.068	86 (24.6%)	51 (22.7%)	86 (24.6%)	51 (22.7%)	86 (24.6%)	51 (22.7%)	86 (24.6%)	51 (22.7%)	86 (24.6%)
Other disease ^a	157 (27.3%)	125 (29.1%)	32 (22.1%)	0.102	118 (28.5%)	39 (24.2%)	0.301	102 (29.1%)	55 (24.4%)	102 (29.1%)	55 (24.4%)	102 (29.1%)	55 (24.4%)	102 (29.1%)	55 (24.4%)	102 (29.1%)
Chemotherapy ^a	34 (5.9%)	28 (6.5%)	6 (4.1%)	0.295	27 (6.5%)	7 (4.3%)	0.321	24 (6.9%)	10 (4.4%)	24 (6.9%)	10 (4.4%)	24 (6.9%)	10 (4.4%)	24 (6.9%)	10 (4.4%)	24 (6.9%)
Surgery ^a	25 (4.3%)	20 (4.7%)	5 (3.4%)	0.539	20 (4.8%)	5 (3.1%)	0.362	17 (4.9%)	8 (3.6%)	17 (4.9%)	8 (3.6%)	17 (4.9%)	8 (3.6%)	17 (4.9%)	8 (3.6%)	17 (4.9%)
Sip feeding ^a	165 (28.7%)	110 (25.6%)	55 (37.9%)	0.004	106 (25.6%)	59 (36.6%)	0.009	92 (26.3%)	73 (32.4%)	92 (26.3%)	73 (32.4%)	92 (26.3%)	73 (32.4%)	92 (26.3%)	73 (32.4%)	92 (26.3%)
Tube feeding ^a	28 (4.9%)	13 (3.0%)	15 (10.3%)	<0.001	13 (3.1%)	15 (9.3%)	0.002	11 (3.1%)	17 (7.6%)	11 (3.1%)	17 (7.6%)	11 (3.1%)	17 (7.6%)	11 (3.1%)	17 (7.6%)	11 (3.1%)
Nausea ^a	70 (12.2%)	66 (15.3%)	4 (2.8%)	<0.001	65 (15.7%)	5 (3.1%)	<0.001	61 (17.4%)	9 (4.0%)	61 (17.4%)	9 (4.0%)	61 (17.4%)	9 (4.0%)	61 (17.4%)	9 (4.0%)	61 (17.4%)
Diarrhoea ^a	43 (7.5%)	35 (8.1%)	8 (5.5%)	0.299	33 (8.0%)	10 (6.2%)	0.471	32 (9.1%)	11 (4.9%)	32 (9.1%)	11 (4.9%)	32 (9.1%)	11 (4.9%)	32 (9.1%)	11 (4.9%)	32 (9.1%)
Swallowing problems ^a	25 (4.3%)	17 (4.0%)	8 (5.5%)	0.425	17 (4.1%)	8 (5.0%)	0.649	17 (4.9%)	8 (3.6%)	17 (4.9%)	8 (3.6%)	17 (4.9%)	8 (3.6%)	17 (4.9%)	8 (3.6%)	17 (4.9%)

^a n (%); ^b mean ± SD; ^c sufficient protein is defined as ≥ 1.2 g/kg bodyweight (weight adjusted when BMI > 27); sufficient energy intake is defined as ≥ 100% of the REE according to Harris and Benedict 1984 (14) plus an additional factor of 30% to correct for activity and/or disease (11;15).

Table 2. Determinants for both protein ^a and energy ^b intake.

	OR	95%CI	p-value
Constant	5.666	-	0.043
Nausea	0.177	0.060 – 0.526	0.002
Cancer	0.566	0.347 – 0.924	0.023
Acute infection	0.633	0.369 – 1.085	0.096
BMI	0.844	0.797 – 0.894	<0.001
Age	1.014	0.999 – 1.030	0.071
Chronic lung disease	3.760	2.331 – 6.065	<0.001
Tube feeding	3.889	1.555 – 9.727	0.004

^a protein intake is defined as ≥ 1.2 g/kg compared to < 1.2 g/kg (weight adjusted when BMI > 27);

^b energy intake is defined as $\geq 100\%$ compared to $< 100\%$ of calculated requirements.

Discussion

The aim of this study was to investigate predictors for achieving protein and energy requirements in undernourished hospitalized patients. Of all patients with known intake, only one in four had a protein and energy intake meeting their requirements at the fourth day of admission. Moreover, we observed that protein requirements were less commonly met than energy requirements. This emphasizes the specific attention that should be paid to protein intake in the treatment of undernutrition.

The results are in line with previous studies of Dupertuis et al (17) and Hiesmayr et al (18), even though these studies used slightly different criteria to measure intake and requirements. The rather small percentage of patients with sufficient protein and energy intake might be explained by the day of evaluation. In The Netherlands, there is consensus on evaluating a patient's intake on the fourth day of admission (22), as mean length of hospital stay is decreasing rapidly. An early evaluation will contribute to more rapid intervention and gives the opportunity to change the nutritional treatment if necessary. Although we realize that possibly not all undernourished patients will be optimally fed within these first four days, we think that a higher percentage should be feasible.

Nausea was found to be the most important dichotomous predictor for not achieving the protein and energy requirements. Prevention or treatment of nausea and vomiting has been described earlier, for instance in the ERAS protocol (29), where it is advised, based on consensus guidelines (30), to avoid emetogenic drugs and use antiemetics in patients with (a risk for) postoperative nausea and vomiting. More research is needed to assess how nausea can be treated in order to improve intake, and how antiemetics can contribute to the treatment of undernourished patients.

A second negative predictor of achieving the requirements was cancer. One could suggest that patients suffering from cancer also experience nausea, however, post-hoc adding an interaction term for cancer and nausea to the final model did not reach statistical significance ($p=0.686$) showing that both are independent predictors. Cancer is associated with malaise complaints, such as anorexia, taste and smell alterations, fatigue, but also pain and anxiety, all associated with decreased intake (27). In this study 37% of the patients were suffering from cancer and only one in six of these patients had sufficient protein and energy intake on the fourth day of admission, indicating that this is an important risk group to target.

The most important dichotomous positive predictor for achieving the requirements is the use of tube feeding during the first four days of hospital stay. Use of tube feeding increases the chance of optimal intake on the fourth day of admission by more than four times. Since only 5% of the population received tube feeding, this should be confirmed in a larger study, though, our results support that for undernourished patients with an expected low intake during a longer period, tube feeding should always be considered, taking into account the risk of developing refeeding syndrome (31).

We also found that patients with chronic lung diseases were more likely to achieve the protein and energy requirements. We have no plausible explanation for this finding. Patients with chronic lung diseases had a mean lower body weight (64.0 ± 14.9 vs. 68.0 ± 13.9 ; $p=0.006$), making it easier to achieve optimal intake levels, but as BMI was present in the final model, the association was independent of bodyweight. Another explanation might be the chronic aspect of this disease. Patients usually have a history of hospital admissions, and visits to the outpatient clinic or general practitioner, where they already may have had nutritional advice and/or support.

Up to now, studies on treatment of undernutrition mainly focused on old and frail undernourished patients, hypothesizing that these patients would have more difficulties in achieving sufficient protein and energy during their hospital stay. In contradiction, this study has shown that younger patients and patients with a higher BMI need as much attention, when it comes to achieving the nutritional goals. Patients with a higher BMI or a lower age will have higher absolute protein and energy requirements, which lower the chances of achieving these requirements on the fourth day of admission. We observed that undernourished patients with a BMI ≥ 25 received sip feeding significantly less often than patients with a lower BMI (14.1% vs. 35.2%; $p<0.001$), which indicates less awareness for undernutrition in overweight patients. We thus concluded that there should be more awareness by healthcare professionals that undernutrition can be prevalent in patients with high bodyweight and younger age as well.

Even though screening and treatment of undernutrition have become performance indicators for all Dutch hospitals (22), 29% of patients were not screened at hospital admission and 26.5% had no data on intake. Therefore, we can not exclude selection and information bias. Still, as this study represents routine care, it is unique that so much data is available on protein and energy intake.

An important limitation of this study is the retrospective data collection. Even though we performed a structured data extraction, we could have missed data because they were not registered during the patients' hospital stay. This might have influenced the final model, which therefore should be treated with some caution. Moreover, missing data on intake could not be verified due to the retrospective character of the study. Having included those patients with missing data could probably have changed the results, either in a positive or a negative way. If all patients without data on intake had had a sufficient protein and energy intake, the percentage of patients meeting the requirements would be 32%. In contrast, if all missing patients would have had an insufficient intake, the percentage of patients with adequate intake would only be 19%. Hence, this does not change the conclusion that intake remains a major problem in undernourished hospital patients.

Another limitation of the retrospective data collection was that we only had data on characteristics reported in the medical or dietetic records, but not on other factors related to intake, such as missing a meal or in-between meal snacks on the first four days of admission, organizational factors, or how patients evaluate their appetite.

A last point of discussion is the fact that optimal protein intake in undernourished patients is still the subject of much discussion. A recent study of Sauerwein and Serlie (2010) recommends a protein intake of 1.5 g/kg/day as optimal amount for non-critically ill patients (32). If we had used this criterion in our sample, only 12% would have met their protein requirement.

The ROC curve for our prediction model showed an AUC of 0.791 indicating that achieving the protein and energy requirements can be moderately predicted by this model of patient related factors. Organizational factors may also be of major importance for a patient's intake, and would certainly improve the prediction model. Several studies described organizational factors that could be associated with undernutrition, like lack of nutritional training and sufficient education amongst all staff groups, confusion regarding nutritional responsibility, failure to record weight and height, lack of adequate staff to assist with serving and feeding and no clearly defined responsibilities in planning and managing nutritional care (33;34). These factors will make it more difficult to achieve optimal protein and energy intake levels, and should be targeted as well. In this study, no

organizational factors have been studied, but most of them are suspected to contribute to the poor intakes in this study as well.

Conclusions

The present study shows that only one out of four undernourished hospital patients meets the predefined protein and energy requirements on the fourth day of admission. A major finding was the result that protein requirements were less commonly met than energy requirements, emphasizing the importance of focusing on adequate protein intake in the treatment of undernutrition. Although this study has some methodological shortcomings, results suggest that nausea, cancer, acute infections, higher BMI, higher age, chronic lung disease, and tube feeding are all predictors for achieving requirements. Based on these findings, we advise to (1) target patients with cancer and acute infections, (2) create awareness among hospital personnel of the fact that undernutrition can be prevalent in patients with higher BMI or younger age as well, (3) use tube feeding when low intake is expected and (4) treat nausea effectively. Future intervention studies should focus on how treatment can be improved to increase food intake and nutrition therapy in undernourished patients.

References

1. Edington J, Boorman J, Durrant ER et al. Prevalence of malnutrition on admission to four hospitals in England. The Malnutrition Prevalence Group. *Clin Nutr* 2000;19:191-5.
2. Halfens RJG, Meijers JMM, Neyens JCL, Offermans MPW. The National Prevalence Study on Care Problems. Maastricht: Datawyse / Universitaire Pers Maastricht; 2007.
3. Kruijenga HM, Wierdsma NJ, van Bokhorst-de van der Schueren MA et al. Screening of nutritional status in The Netherlands. *Clin Nutr* 2003;22:147-52.
4. Kyle UG, Pirlich M, Schuetz T, Luebke HJ, Lochs H, Pichard C. Prevalence of malnutrition in 1760 patients at hospital admission: a controlled population study of body composition. *Clin Nutr* 2003;22:473-81.
5. Meijers JM, Halfens RJ, van Bokhorst-de van der Schueren MA, Dassen T, Schols JM. Malnutrition in Dutch health care: prevalence, prevention, treatment, and quality indicators. *Nutrition* 2009;25:512-9.
6. Norman K, Pichard C, Lochs H, Pirlich M. Prognostic impact of disease-related malnutrition. *Clin Nutr* 2008;27:5-15.
7. Stratton RJ, Hackston A, Longmore D et al. Malnutrition in hospital outpatients and inpatients: prevalence, concurrent validity and ease of use of the Malnutrition Screening Tool Universal Tool (MUST) for adults. *British Journal of Nutrition* 2004;92:799-808.
8. Stratton RJ, Green CJ, Elia M. Disease related malnutrition: an evidence-based approach to treatment. 1 ed. Cambridge: CABI Publishing 2003:1-34.
9. Correia MI, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. *Clin Nutr* 2003;22:235-9.
10. Stratton RJ, Green CJ, Elia M. Causes of disease-related malnutrition. 1 ed. Disease related malnutrition: an evidence-based approach to treatment. Cambridge: CABI Publishing 2003:93-112.
11. Sauerwein HP, Strack van Schijndel RJ. Perspective: How to evaluate studies on peri-operative nutrition? Considerations about the definition of optimal nutrition for patients and its key role in the comparison of the results of studies on nutritional intervention. *Clin Nutr* 2007;26:154-8.
12. Ishibashi N, Plank LD, Sando K, Hill GL. Optimal protein requirements during the first 2 weeks after the onset of critical illness. *Crit Care Med* 1998;26:1529-35.
13. Shaw JH, Wildbore M, Wolfe RR. Whole body protein kinetics in severely septic patients. The response to glucose infusion and total parenteral nutrition. *Ann Surg* 1987;205:288-94.
14. Roza AM, Shizgal HM. The Harris Benedict equation reevaluated: resting energy requirements and the body cell mass. *Am J Clin Nutr* 1984;40:168-82.
15. Weijs PJ, Kruijenga HM, van Dijk AE et al. Validation of predictive equations for resting energy expenditure in adult outpatients and inpatients. *Clin Nutr* 2008;27:150-7.
16. Harris JA and Benedict FG. A biometric study of basal metabolism in man. Washington DC: Carnegie Institute of Washington; 1919. Report No.: publication no. 297.
17. Dupertuis YM, Kossovsky MP, Kyle UG, Raguso CA, Genton L, Pichard C. Food intake in 1707 hospitalised patients: a prospective comprehensive hospital survey. *Clin Nutr* 2003;22:115-23.

18. Hiesmayr M, Schindler K, Pernicka E et al. Decreased food intake is a risk factor for mortality in hospitalised patients: the NutritionDay survey 2006. *Clin Nutr* 2009;28:484-91.
19. Kruizenga HM, Seidell JC, de Vet HC, Wierdsma NJ, van Bokhorst-de van der Schueren MA. Development and validation of a hospital screening tool for malnutrition: the short nutritional assessment questionnaire (SNAQ). *Clin Nutr* 2005;24:75-82.
20. Westenbrink S, Jansen-van der Vliet M, Brants HAM et al. NEVO Dutch food composition table 2006. The Hague: The Netherlands Nutrition Centre, 2006.
21. Donders-Engelen, M. R., Van der Heyden, L., and Hulshof, K. F. A. M. Directives for Sizes and Weights. Human Nutrition, Wageningen University and TNO Nutrition and Food Research Institute Zeist; 1997.
22. Dutch Health Care Inspectorate. Performance indicators for risk steering supervision 2008. Utrecht; 2007.
23. Dutch Institute for Healthcare Improvement CBO. Guideline Perioperative Nutrition. Utrecht; 2007.
24. Argiles JM. Cancer-associated malnutrition. *Eur J Oncol Nurs* 2005;9 Suppl 2:S39-S50.
25. Batres SA, Leon JV, Álvarez-Sala R. Nutritional Status in COPD. *Arch Bronconeumol* 2007;43:283-8.
26. Valentini L, Schaper L, Buning C et al. Malnutrition and impaired muscle strength in patients with Crohn's disease and ulcerative colitis in remission. *Nutrition* 2008;24:694-702.
27. Van Cutsem E, Arends J. The causes and consequences of cancer-associated malnutrition. *Eur J Oncol Nurs* 2005;9 Suppl 2:S51-S63.
28. Kruizenga HM, de Jonge P, Seidell JC et al. Are malnourished patients complex patients? Health status and care complexity of malnourished patients detected by the Short Nutritional Assessment Questionnaire (SNAQ). *Eur J Intern Med* 2006;17:189-94.
29. Fearon KC, Ljungqvist O, von Meyenfeldt MF et al. Enhanced recovery after surgery: a consensus review of clinical care for patients undergoing colonic resection. *Clin Nutr* 2005;24:466-77.
30. Gan TJ, Meyer T, Apfel CC et al. Consensus guidelines for managing postoperative nausea and vomiting. *Anesth Analg* 2003;97:62-71, table.
31. Mehanna HM, Moledina J, Travis J. Refeeding syndrome: what it is, and how to prevent and treat it. *BMJ* 2008;336:1495-8.
32. Sauerwein HP, Serlie MJ. Optimal nutrition and its potential effect on survival in critically ill patients. *Neth J Med* 2010;68:119-22.
33. Bavelaar JW, Otter CD, van Bodegraven AA, Thijs A, van Bokhorst-de van der Schueren MA. Diagnosis and treatment of (disease-related) in-hospital malnutrition: the performance of medical and nursing staff. *Clin Nutr* 2008;27:431-8.
34. Kondrup J, Johansen N, Plum LM et al. Incidence of nutritional risk and causes of inadequate nutritional care in hospitals. *Clin Nutr* 2002;21:461-8.



Chapter 4

Prevalence of undernutrition in hospital outpatients



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Abstract

Background. The prevalence of undernutrition in hospital inpatients is high. Earlier detection and treatment in the hospital outpatient clinic may help to reduce these numbers. The purpose of this study was to assess the prevalence of undernutrition in hospital outpatients in the Netherlands, to determine high risk departments, and to determine the percentage of patients receiving dietetic treatment.

Methods. This cross-sectional multicenter study was conducted in nine hospitals. Patients who visited the outpatient clinic on one of the screening days in the period March-May 2008 received a short questionnaire and were weighed. Patients were classified as severely undernourished, moderately undernourished or not undernourished.

Results. 2288 patients were included in the study, of which 5% were severely undernourished and 2% were moderately undernourished. The prevalence of severe undernutrition was highest in the outpatient departments of oral maxillofacial surgery (17%), oncology (10%), rehabilitation (8%), gastroenterology (7%) and pulmonology (7%). Only 17% of all severely undernourished and 4% of all moderately undernourished patients reported to receive dietetic treatment.

Conclusion. The prevalence of undernutrition in hospital outpatients is generally low but largely undertreated. Future screening should focus on high risk departments.

Introduction

Undernutrition is an extensive problem in health care. The prevalence of disease related undernutrition varies from 25-40% in hospital inpatients to 20-25% in nursing homes and 15-25% in homecare units (1-7). Undernutrition can be defined as a state of nutrition in which a deficiency or imbalance of energy, protein and other nutrients causes measurable adverse effects on tissue or body form (body shape, size, composition), function, and clinical outcome (8). Several studies show that undernutrition is associated with decreased body function (5;6;9-13), higher care complexity (10), increased mortality, length of hospital stay and extra costs in health care (5;6;10;14-17). Early recognition and treatment is important in order to reduce these consequences.

In the hospital setting, there is growing awareness that undernutrition plays an important role in the course of treatment of patients (3). However, the prevalence of undernutrition at hospital admission has only slightly decreased over the last few years (7). This indicates that undernutrition has to be recognized and treated in an earlier stage, such as in general practices or at the outpatient clinic. In these settings generally no structural screening on malnutrition takes place.

To determine how screening and treatment in the outpatient clinic can be optimized, prevalence rates, high risk departments and bottlenecks need to be identified. However, only limited data is available for this setting. Wilson et al (1998) studied the prevalence of undernutrition in non-cancer hospital outpatients and identified undernutrition in 11% of patients of 65 years and older, and 7% in patients younger than 65 (18). A study carried out on the preoperative outpatient department (19) and yet unpublished data collected at the general outpatient departments of our hospital revealed prevalence data ranging from 6% to 7%. While these studies provide an indication of the prevalence of outpatient undernutrition, their results cannot be extrapolated to outpatient departments in general.

The aim of this study was to determine the prevalence of undernutrition in outpatient departments of nine different hospitals in The Netherlands, to identify high risk departments, and to determine the percentage of patients receiving dietetic treatment.

Materials and Methods

Patients

This cross-sectional multicenter study was carried out in nine hospitals in The Netherlands, participating in the implementation program 'Early recognition and optimal treatment of malnourished hospital patients'. Participating hospitals were either general (Gelderse

Vallei Hospital, Ede (n=116); Maasstad Hospital, Rotterdam (n=508)), teaching (Amphia Hospital, Breda/Oosterhout (n=322); Catharina Hospital, Eindhoven (n=446); Canisius Wilhelmina Hospital, Nijmegen (n=348); Haga Hospital, The Hague (n=192); Martini Hospital, Groningen (n=124); Máxima Medical Center, Veldhoven (n=160)) or university hospitals (VU University Medical Center, Amsterdam (n=72)).

All patients who visited the outpatient clinic of these hospitals on one of the screening days in the period March until May 2008 entered the study. The number of outpatient departments participating in the study varied per hospital (1-18).

Patients were not included in the study when they were <18 years of age, pregnant or had been pregnant in the last six months. A total of 2584 patients filled out the questionnaire. Of these, 296 patients (11%) were excluded because nutritional status could not be defined due to missing data on height and/or weight, leaving 2288 patients in the analytic sample.

Multicenter approval was given by the ethical review board of the VU University Medical Center. Because of the low subject burden and the fact that data were collected, handled and stored anonymously, informed consent was not considered necessary by the ethical review board.

Methods

Administrative personnel of the outpatient departments and research assistants handed out a questionnaire to all patients who registered at the participating outpatient clinic. Research assistants were nurses, dieticians and medical or dietetic students who were instructed by the coordinating dietician of the hospital. The questionnaire consisted of questions about age, gender, height, recent weight loss (one and six months), (reason for) current dietetic treatment, reason for visiting the outpatient clinic and whether patients had cancer, a gastrointestinal disease, a chronic lung disease or were elective for surgery, which are high risk groups in the hospital setting and are thought to be high risk groups for the outpatient clinic as well (1;3;6;19;20). Because of the confronting character, the last three questions were used by only five of the nine hospitals (gastrointestinal disease n=1231; chronic lung disease n=1226; elective for surgery n=1229). The question about cancer was used by only four hospitals for the same reason (n=1065).

After completing the questionnaire, trained research assistants measured the patients' actual weight on a calibrated scale. Patients were weighed wearing indoor clothing without shoes. An adjustment for clothing was made by deducting 1.77 kg for men and

1.13 kg for women from their weight (21). An additional correction of 0.40 kg for men and 0.28 kg for women was made when a patient was unable to take off his shoes (21).

Height was asked for and when patients did not know their actual height, research assistants measured the patients' lower leg length (knee height) with a flexible measure tape from the top of the patella with knee flexed at 90 degrees while the patient was sitting (n=92). Body height was estimated based on patients' lower leg length, adjusted for age and gender (22). In four of the nine hospitals, patients' actual height was measured with a stadiometer (n=858).

Nutritional status

Nutritional status was defined by involuntary weight loss and body mass index (BMI). BMI was calculated as measured body weight (kg) / height (m)². Patients were characterized as severely undernourished when one or more of the following conditions were present: a BMI < 18.5 kg/m² and/or unintentional weight loss of more than 5% in the last month or more than 10% in the last six months (8;23). Patients with a BMI ≥ 18.5 kg/m², but with 5-10% unintentional weight loss in the last six months were characterized as moderately undernourished (8;23).

Statistics

The study population was categorized into three groups based on nutritional status (severely undernourished, moderately undernourished, not undernourished) and prevalence was calculated for different outpatient departments and type of illness. Descriptive statistics were used to express means, standard deviations, percentages and frequencies. ANOVA and chi-square tests were used to test the relationship of outpatient characteristics with nutritional status and receiving dietetic treatment. Logistic regression analysis was used to test the relationship of department and disease with nutritional status (undernutrition versus no undernutrition). Results were expressed as odds ratios (OR) and 95% confidence intervals (95% CI). For the relation between type of hospital and nutritional status, the university hospital was left out, since this hospital participated with only one outpatient department. Differences were considered statistically significant at p<0.05. Statistical analyses were performed in SPSS 15.0 for Windows (SPSS Inc. Chicago IL., USA).

Results

A total of 2288 patients (47.5% male, 53.5% female) were included in the study. Mean age was 56.5 (± 16.3) years and varied from 18 to 94 years. The mean age was not different between patients who were included (age=56.5) and those excluded because of missing weight and height (age=57.9; $p=0.19$). There was a tendency that those who were included were more likely to be male (47.5% versus 42.5%; $p=0.07$).

Table 1 shows the characteristics of the patients who participated in the study. Of all patients, 117 patients (5%) were severely undernourished, 46 patients (2%) were moderately undernourished and 2125 patients (93%) were not undernourished. In the group with no undernutrition, 823 patients (39%) were overweight and 435 patients (21%) were obese. Patients were classified as severely undernourished based on either BMI $< 18.5 \text{ kg/m}^2$ (38%), unintentional weight loss (57%) ($>5\%$ in the last month (20%), $>10\%$ in the last six months (21%), or both (16%)), or a combination of low BMI and unintentional weight loss (5%).

There was no difference in the prevalence of undernutrition between men (6.7%) and women (7.5%; $p=0.48$), patients of 60 years and older (8.1%) and patients younger than 60 years (6.3%; $p=0.11$), and between general (7.9%) and teaching hospitals (6.5%; $p=0.25$).

Table 1. Characteristics of outpatients divided by nutritional status (n=2288).

	Severely under-nourished ^a	Moderately under-nourished ^b	Not under-nourished ^c	p-value
n (%)	117 (5.1%)	46 (2.0%)	2125 (92.9%)	
Female (%)	51.3%	65.2%	52.3%	0.215 [#]
Age (y) \pm SD	56.5 \pm 20.3	58.5 \pm 16.0	56.5 \pm 16.0	0.707 [‡]
Age \geq 60 years (%)	52.1%	54.3%	46.2%	0.263 [#]
BMI (kg/m^2) \pm SD	21.0 \pm 4.2	24.3 \pm 3.9	26.8 \pm 4.9	<0.001 [‡]
BMI $< 18.5 \text{ kg/m}^2$, n (%)	50 (42.7%)	-	-	
BMI 18.5-25 kg/m^2 , n (%)	50 (42.7%)	28 (60.9%)	867 (40.8%)	
BMI 25-30 kg/m^2 , n (%)	11 (9.4%)	13 (28.3%)	823 (38.7%)	
BMI $> 30 \text{ kg/m}^2$, n (%)	6 (5.1%)	5 (10.9%)	435 (20.5%)	
Nutritional treatment, n (%)	20 (17.1%)	2 (4.3%)	189 (8.9%) ^d	0.006 [#]

[‡] ANOVA; [#] chi-square.

^a BMI $< 18.5 \text{ kg/m}^2$ and/or (unintentional weight loss of $>5\%$ in the last month or $>10\%$ in the last six months); ^b BMI $\geq 18.5 \text{ kg/m}^2$ and 5-10% unintentional weight loss in the last six months; ^c BMI $\geq 18.5 \text{ kg/m}^2$ and $<5\%$ unintentional weight loss in the last six months.; ^d n=2116.

Table 2. Nutritional status in outpatient departments (n=2288).

	no. of hospitals	n (%)	Severely undernourished ^a n (%)	Moderately undernourished ^b n (%)	Not undernourished ^c n (%)	OR (95% CI) ^d
Oral maxillofacial surgery	2	30 (1.3%)	5 (16.7%)	-	25 (83.3%)	2.66 (1.00–7.04)
Oncology	5	126 (5.5%)	12 (9.5%)	8 (6.3%)	106 (84.1%)	2.66 (1.60–4.42)
Rehabilitation	3	37 (1.6%)	3 (8.1%)	-	34 (91.9%)	1.15 (0.35–3.80)
Gastroenterology	7	190 (8.3%)	13 (6.8%)	6 (3.2%)	129 (90.0%)	1.51 (0.91–2.49)
Pulmonology	7	133 (5.8%)	9 (6.8%)	1 (0.8%)	123 (92.5%)	1.06 (0.55–2.07)
Urology	5	78 (3.4%)	5 (6.4%)	-	73 (93.6%)	0.89 (0.35–2.23)
Radiotherapy	1	48 (2.1%)	3 (6.3%)	2 (4.2%)	43 (89.6%)	1.53 (0.60–3.92)
Vascular surgery	1	69 (3.0%)	4 (5.8%)	1 (1.4%)	64 (92.8%)	1.02 (0.40–2.59)
Surgery	9	386 (16.9%)	22 (5.7%)	12 (3.1%)	352 (91.2%)	1.33 (0.90–1.97)
Dermatology	4	111 (4.9%)	6 (5.4%)	1 (0.9%)	104 (93.7%)	0.87 (0.40–1.91)
Internal medicine	8	306 (13.4%)	14 (4.6%)	6 (2.0%)	286 (93.5%)	0.90 (0.55–1.46)
Otolaryngology	4	87 (3.8%)	4 (4.6%)	-	83 (95.4%)	0.62 (0.22–1.71)
Cardiology	5	135 (5.9%)	6 (4.4%)	-	129 (95.6%)	0.59 (0.26–1.36)
Ophthalmology	4	51 (2.2%)	2 (3.9%)	2 (3.9%)	47 (92.2%)	1.11 (0.40–3.13)
Nephrology	3	122 (5.3%)	3 (2.5%)	2 (1.6%)	117 (95.9%)	0.54 (0.22–1.35)
Neurology	6	140 (6.1%)	3 (2.1%)	2 (1.4%)	135 (96.4%)	0.47 (0.19–1.16)
Rheumatology	4	52 (2.3%)	1 (1.9%)	-	51 (98.1%)	0.25 (0.03–1.83)
Orthopedics	5	109 (4.8%)	2 (1.8%)	1 (0.9%)	106 (97.2%)	0.36 (0.11–1.14)
Gynaecology	5	46 (2.0%)	-	1 (2.2%)	45 (97.8%)	0.29 (0.04–2.08)
Others ³	5	32 (1.4%)	-	1 (3.1%)	31 (96.9%)	0.42 (0.06–3.07)
Total		2288 (100%)	117 (5.1%)	46 (2.0%)	2125 (92.9%)	

^a BMI < 18.5 kg/m² and/or unintentional weight loss of >5% in the last month or >10% in the last six months; ^b BMI ≥ 18.5 kg/m² and 5–10% unintentional weight loss in the last six months; ^c BMI ≥ 18.5 kg/m² and <5% unintentional weight loss in the last six months; ^d OR's present the odds of being undernourished in a certain department compared to all other departments, and are based on the combination of severely and moderately undernourished patients versus not undernourished patients; ^e Others: psychiatry (n=17), radiology (n=8), geriatrics (n=5), physiotherapy (n=2).

Dietetic treatment

Seventeen percent of the severely undernourished patients and 4% of the moderately undernourished patients reported to receive dietetic treatment. In the group with no undernutrition, 6% (n=49) of the normal weight, 9% (n=75) of the overweight and 15% (n=65) of the obese patients received dietetic treatment. In undernourished patients, having cancer (48.2% versus 10.9% in persons with no cancer; $p=0.03$) and being treated at the department of radiotherapy (66.7% versus 15.8%; $p=0.02$) were positively associated with treatment by a dietitian. Being treated at the department of surgery (0.0% versus 21.1%; $p=0.02$) was negatively associated with receiving dietetic treatment.

Reasons for receiving dietetic treatment in patients with severe undernutrition were: (risk for) undernutrition (60%), diabetes (10%), gastrointestinal disease (5%), or not reported (25%). Reasons for receiving dietetic treatment in patients with no undernutrition were: diabetes (44%), overweight/obesity (21%), other diseases (25%), non-classifiable (3%), or not reported (7%).

Outpatient departments

Table 2 presents the number of patients at each outpatient department by nutritional status. The prevalence of severe undernutrition was highest in the department of oral maxillofacial surgery (17%), followed by the departments of oncology (10%), rehabilitation (8%), gastroenterology (7%) and pulmonology (7%). The prevalence of undernutrition in general (both severe and moderate undernutrition) was high in the departments of radiotherapy and general surgery as well. Undernutrition in general was significantly elevated in the department of oral maxillofacial surgery and the department of oncology compared to the other departments.

Type of diseases

Table 3 shows the distribution of nutritional status in patients with gastrointestinal diseases, oncological diseases, chronic lung diseases and patients elective for surgery. Nine percent of the patients with a gastrointestinal disease were severely undernourished, which was a statistically higher prevalence compared to that in patients without this disease. For patients with oncological diseases, chronic lung diseases and patients elective for surgery the prevalence was 7%, 6% and 4% respectively.

There was no difference in terms of age ($p=0.88$), gender ($p=0.31$) or BMI ($p=0.61$) between hospitals who asked patients' whether they had these diseases and hospitals who left out these questions. However, in the hospitals who left out these questions, the prevalence of undernutrition was 5.5% ($n=57$) compared with 4.8% ($n=60$) in the rest of the population ($p=0.03$).

Table 3. Nutritional status for different types of disease[#]

		Severely under- nourished ^a	Moderately under- nourished ^b	Not under- nourished ^c	OR (95% CI) ^d
	n (%)	n (%)	n (%)	n (%)	
Gastrointestinal disease (response=1231)	129 (10.5%)	11 (8.5%)	2 (1.6%)	116 (89.9%)	1.95 (1.04–3.65)
Cancer (response=1065)	99 (9.3%)	7 (7.1%)	3 (3.0%)	89 (89.9%)	1.86 (0.92–3.78)
Chronic lung disease (response=1226)	180 (14.7%)	10 (5.6%)	1 (0.6%)	169 (93.9%)	1.03 (0.53–2.00)
Elective for surgery (response=1229)	108 (8.8%)	4 (3.7%)	-	104 (96.3%)	0.58 (0.21–1.61)

^a BMI < 18.5 kg/m² and/or unintentional weight loss of >5% in the last month or >10% in the last six months; ^b BMI ≥ 18.5 kg/m² and 5-10% unintentional weight loss in the last six months; ^c BMI ≥ 18.5 kg/m² and <5% unintentional weight loss in the last six months; ^d OR's present the odds of being undernourished when having a certain disease state compared to not having this disease state, and are based on the combination of severely and moderately undernourished patients versus not undernourished patients.

[#] Patients could have had more than one disease (284 patients had one disease, 61 patients had two diseases, 6 patients had three diseases and 3 patients had all four diseases).

Discussion

In this first, large, cross-sectional multicenter study on undernutrition in the outpatient departments of nine Dutch hospitals, 5% of all outpatients were severely undernourished and 2% were moderately undernourished. There were no significant differences in the prevalence of undernutrition according to age, sex or type of hospital. However, clear differences were observed between outpatient departments. Only 17% of the severely undernourished patients and 4% of the moderately undernourished patients received some form of dietetic treatment.

To the best of our knowledge, this is the first multicenter study on the prevalence of undernutrition in hospital outpatients. Since the results are based on data of 2288 patients from either university, teaching and general hospitals, individual hospitals showed only small differences in prevalence. These results about the prevalence of undernutrition in outpatients are in line with the results of Neelemaat et al (19) and with yet unpublished data from our hospital where 6-7% of the patients were undernourished. Moreover, the observed prevalence of undernourished patients receiving dietetic treatment of 15% is also in line with our earlier (unpublished) work. As data seem comparable to these previous studies, we suggest that our current results can be extrapolated to the hospital outpatient population in general in the Netherlands. Because there are only two non-Dutch studies to compare with, and these studies used different definitions of undernutrition (18;24), we cannot state that results can be generalized to all Western countries. However, there is no reason to assume large differences between countries.

The absence of a golden standard for disease-related undernutrition is an important point of discussion. In order to be able to compare studies on the prevalence of undernutrition, it is crucial for all studies to use the same universal definition. In this study, we used a definition of undernutrition based on percentage unintentional weight loss and BMI, which is a commonly used and accepted definition (8;23).

Similar to a previous study (19) and to yet unpublished data from our hospital, severe undernutrition was most prevalent in the outpatient departments of oral maxillofacial surgery (17%), oncology (10%), rehabilitation (8%), gastroenterology (7%) and pulmonology (7%). Overall undernutrition was also high in the departments of radiotherapy and general surgery. However, the prevalence of undernutrition was only significantly higher in the department of oral maxillofacial surgery and the department of oncology when compared with the other departments. Since the results for the department of oral maxillofacial surgery were mainly based on a single hospital and 30 patients only, and taking into consideration the broad confidence interval, the relatively higher prevalence of undernutrition in this department has to be interpreted with caution. On the other hand, no oncological (e.g. head and neck cancer) patients were present in this department during the measurements, while these patients are especially known to have a high risk for undernutrition (25). Therefore, the prevalence of undernutrition is expected to be even higher in this department.

The prevalence of undernutrition in the department of rehabilitation was 8% and similar to that of the oncology and gastroenterology departments. Since this is the first study to

include a rehabilitation department and since results are based on data of 37 patients only, more research is required to confirm these results.

The questions about type of diseases revealed that the prevalence of undernutrition was higher in patients with a gastrointestinal disease (9%) compared to patients without this disease. Patients from hospitals who left out these questions had a slightly yet statistically higher prevalence of undernutrition. However, since it were the hospitals who choose to leave out these questions and not the patients who decided not to respond to these questions, we cannot explain this difference.

Seventeen percent of severely undernourished patients reported to receive dietetic treatment. This was significantly higher compared to the moderately undernourished (4% dietetic treatment) and not undernourished patients (9%) ($p=0.01$), but still largely insufficient. These data are comparable to clinical studies (26), that showed that malnourished patients are indeed more often referred to a dietician, but that the number of referrals is still very low.

Despite the low prevalence of undernutrition in the outpatient departments, the prevalence of another malnutrition problem, overweight and obesity, was considerable in the not undernourished population (39% and 21% respectively). This was in line with the prevalence of overweight and obesity in an earlier study at our hospital (unpublished data). Moreover, only 9% of the patients with overweight and 15% of the patients with obesity received dietetic treatment, which indicates that dietetic treatment of these patients is also far from optimal. It implies that not only undernourished patients, but also overweight patients, should be referred to a dietician more frequently.

Since all hospitals participating in the study were already active in screening for undernutrition in hospitalized patients, data can be slightly biased. Given the low prevalence of dietetic treatment, however, this is not expected.

A methodological point of discussion is the difference in height measurement. In five of the nine hospitals, patients' height was based on self-report height or based on measured lower leg length, because it was not feasible to use a stadiometer on each department. In the other four hospitals, a stadiometer was present at each outpatient department, so patients' height was measured. There were however no statistical differences in either height ($p=0.18$) or nutritional status ($p=0.73$) between the two hospital groups.

On or near every department, one or more research assistants and local staff were present and every patient received a questionnaire at admission. We therefore expect the

number of non-participants to be insignificant. We cannot exclude that the few patients who did not want to participate had a different health status and nutritional status compared to those who were included in the study. Furthermore, even though research assistants were well-instructed, 11% of the patients who filled out a questionnaire were excluded because missing data on height and/or weight. The reported reasons for missing data were: lack of time, patient refusal and patients who were wheelchair dependent and could not be weighed. Although the patients included and excluded in our study were of similar age and gender, this selection bias may have led to an underestimation of the prevalence of undernutrition. To further examine this, we performed a post-hoc analysis using data from 47 excluded patients who could not be weighed (60% female, mean age 65 ± 16.7 y) but did provide a self-reported body weight. The prevalence of moderate and severe undernutrition in this population was 2% and 11% respectively, supporting a potential underestimation of undernutrition in our study. However, these data should also be carefully interpreted since there was a significant difference of -1.5 kg between self-reported and measured weight ($p < 0.001$), suggesting that patients generally underestimated their weight. By using self-reported weight for the total population, the prevalence of severe undernutrition indeed increased to 6%.

In conclusion, our findings indicate that the prevalence of undernutrition in hospital outpatients is generally low but can be as high as 17% in specific departments. Furthermore, the results suggest that both undernutrition and obesity are severely undertreated. Because both undernutrition and overweight are known to influence the course of medical treatment, nutritional status should ideally be assessed in every patient. Screening systematically for undernutrition at high risk outpatient departments should be considered.

References

1. Baldwin C, Parsons T, Logan S. Dietary advice for illness-related malnutrition in adults. *Cochrane Database Syst Rev* 2007;CD002008.
2. Edington J, Boorman J, Durrant ER et al. Prevalence of malnutrition on admission to four hospitals in England. The Malnutrition Prevalence Group. *Clin Nutr* 2000;19:191-5.
3. Kruizenga HM, Wierdsma NJ, van Bokhorst-de van der Schueren MA et al. Screening of nutritional status in The Netherlands. *Clin Nutr* 2003;22:147-52.
4. Kyle UG, Pirlich M, Schuetz T, Luebke HJ, Lochs H, Pichard C. Prevalence of malnutrition in 1760 patients at hospital admission: a controlled population study of body composition. *Clin Nutr* 2003;22:473-81.
5. Norman K, Pichard C, Lochs H, Pirlich M. Prognostic impact of disease-related malnutrition. *Clin Nutr* 2008;27:5-15.
6. Green CJ. Existence, causes and consequences of disease related malnutrition in the hospital and the community, and clinical and financial benefits of nutritional intervention. *Clin Nutr* 1999;18:3-28.
7. Halfens, RJG, Meijers, JMM, Neyens, JCL, and Offermans, MPW. The National Prevalence Study on Care Problems. Maastricht: Datawyse / Universitaire Pers Maastricht; 2007.
8. Stratton RJ, Green CJ, Elia M. Disease related malnutrition: an evidence-based approach to treatment. 1 ed. Cambridge: CABI Publishing 2003:1-34.
9. Humphreys J, de la Maza P, Hirsch S, Barrera G, Gattas V, Bunout D. Muscle strength as a predictor of loss of functional status in hospitalized patients. *Nutrition* 2002;18:616-20.
10. Kruizenga HM, de Jonge P, Seidell JC et al. Are malnourished patients complex patients? Health status and care complexity of malnourished patients detected by the Short Nutritional Assessment Questionnaire (SNAQ). *Eur J Intern Med* 2006;17:189-94.
11. Norman K, Schutz T, Kemps M, Josef Lübke H, Lochs H, Pirlich M. The Subjective Global Assessment reliably identifies malnutrition-related muscle dysfunction. *Clin Nutr* 2005;24:143-50.
12. Russell L. The importance of patients' nutritional status in wound healing. *Br J Nurs* 2001;10(6):S42-S49.
13. van Bokhorst-de van der Schueren MAE, Von Blomberg-van der Flier BME, Riezebos RK et al. Differences in immune status between well-nourished and malnourished head and neck cancer patients. *Clin Nutr* 1998;17:107-11.
14. Correia MI, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. *Clin Nutr* 2003;22:235-9.
15. Kruizenga HM, Van Tulder MW, Seidell JC, Thijs A, Ader HJ, van Bokhorst-de van der Schueren MA. Effectiveness and cost-effectiveness of early screening and treatment of malnourished patients. *Am J Clin Nutr* 2005;82:1082-9.
16. Pichard C, Kyle UG, Morabia A, Perrier A, Vermeulen B, Unger P. Nutritional assessment: lean body mass depletion at hospital admission is associated with an increased length of stay. *Am J Clin Nutr* 2004;79:613-8.

17. Kyle UG, Pirlich M, Lochs H, Schuetz T, Pichard C. Increased length of hospital stay in underweight and overweight patients at hospital admission: a controlled population study. *Clin Nutr* 2005;24:133-42.
18. Wilson MM, Vaswani S, Liu D, Morley JE, Miller DK. Prevalence and causes of undernutrition in medical outpatients. *Am J Med* 1998;104:56-63.
19. Neelemaat F, Kruizenga HM, de Vet HC, Seidell JC, Buttermann M, van Bokhorst-de van der Schueren MA. Screening malnutrition in hospital outpatients. Can the SNAQ malnutrition screening tool also be applied to this population? *Clin Nutr* 2008;27:439-46.
20. Stratton RJ, Green CJ, Elia M. Prevalence of Disease-related Malnutrition. 1 ed. In: Stratton RJ, Green CJ, Elia M, eds. *Disease-related Malnutrition: An Evidence-based Approach to Treatment*. Cambridge: CABI Publishing 2003:35-92.
21. Frank E, Dunlop AL. What does a patient's outfit weigh? *Fam Med* 2000;32:595-6.
22. Han TS, Lean ME. Lower leg length as an index of stature in adults. *Int J Obes Relat Metab Disord* 1996;20:21-7.
23. Detsky AS, Smalley PS, Chang J. Is this patient malnourished? *JAMA* 1994;271:54-8.
24. Bozzetti F. Screening the nutritional status in oncology: a preliminary report on 1,000 outpatients. *Support Care Cancer* 2008.
25. van Bokhorst-de van der Schueren M.A.E, van Leeuwen PA, Sauerwein HP, Kuik DJ, Snow GB, Quak JJ. Assessment of malnutrition parameters in head and neck cancer and their relation to postoperative complications. *Head Neck* 1997;19:419-25.
26. Bavelaar JW, Otter CD, van Bodegraven AA, Thijs A, van Bokhorst-de van der Schueren MA. Diagnosis and treatment of (disease-related) in-hospital malnutrition: the performance of medical and nursing staff. *Clin Nutr* 2008;27:431-8.



Chapter 5

Validity of nutritional screening with MUST and SNAQ in hospital outpatients



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Abstract

Background. The majority of hospital outpatients with undernutrition is unrecognized and therefore untreated. There is a need for an easy and valid screening tool to detect undernutrition in this setting. The aim of this study was to determine the diagnostic accuracy of the MUST and SNAQ tools for undernutrition screening in hospital outpatients.

Methods. In a large multicenter hospital outpatient population, patients were classified: severely undernourished (BMI<18.5 (<65y) or <20 (≥65y) and/or unintentional weight loss ≥5% in the last month or ≥10% in the last six months), moderately undernourished (BMI 18.5-20 (<65y) or 20-22 (≥65y) and/or 5-10% unintentional weight loss in the last six months) or not undernourished. Diagnostic accuracy of the screening tools versus the reference method was expressed as sensitivity (Se), specificity (Sp), positive predictive value (PPV) and negative predictive value (NPV).

Results. Out of 2236 outpatients, 6% were severely and 7% were moderately undernourished according to the reference method. MUST and SNAQ identified 9% and 3% as severely undernourished respectively. MUST had a low PPV (Se=75, Sp=95; PPV=48; NPV=98) whereas SNAQ had a low sensitivity (Se=43, Sp=99, PPV=78, NPV=96).

Conclusions. The validity of MUST and SNAQ is insufficient for hospital outpatients. While SNAQ identifies too few patients as undernourished, MUST identifies too many patients as undernourished. We advise to measure body weight, height and weight loss, in order to define undernutrition in hospital outpatients.

Introduction

Disease-related undernutrition continues to be a substantial problem in all healthcare settings. Undernutrition is prevalent in about 25-40% of hospitalized patients (1;2) and is associated with higher care complexity, longer length of stay, and increased morbidity and mortality (2-6). Because undernutrition is often already present at hospital admission, and nutritional status deteriorates further during hospital admission, continuous nutritional care is essential. Nowadays, nutritional screening in the outpatient clinic becomes more important, due to declining length of hospital stay and, consequently, the shorter time to improve nutritional status during admission. Outpatient screening enables us to start early nutritional intervention which may improve the condition of the hospital patient at nutritional risk.

The prevalence of undernutrition among hospital outpatients is relatively low (6-13%) (7-9). However, due to the large numbers of outpatients visiting the hospitals, this adds up to thousands of undernourished patients per year (10). A recent multicenter study in hospital outpatient departments has shown that only 17% of undernourished patients received dietetic treatment (7), suggesting that recognition and treatment of undernutrition is insufficient.

In order to early recognize undernourished patients in the outpatient setting, a screening tool to identify undernourished outpatients is required. However, none of the available screening tools has been developed and validated specifically for the outpatient setting. For hospital inpatients several undernutrition screening tools have been developed over the past decade (11-15). In the Netherlands, Malnutrition Universal Screening Tool (MUST) (14) and Short Nutritional Assessment Questionnaire (SNAQ) (15) are the only used screening tools for screening of hospital inpatients. MUST was developed for all health care settings and patient groups, in which 50 consecutive patients visiting the gastroenterology outpatient clinic were included (14). However, no study has been performed on the diagnostic accuracy of this screening tool for a more diverse group of hospital outpatients. SNAQ was initially developed for hospital inpatients. A recent study on the diagnostic accuracy of this screening tool showed fair validity (sensitivity 45-67%; specificity 95-99%) for hospital outpatients in a single university hospital (8), suggesting its limited usefulness for hospital outpatients.

The aim of this multicenter study was therefore to determine the diagnostic accuracy of MUST and SNAQ for undernutrition screening in a large and diverse sample of hospital outpatients.

Patients and Methods

Patients

This study was performed in 2008 as a cross-sectional multicenter study carried out in nine hospitals in the Netherlands (7). Participating hospitals were two general hospitals (n=734), six teaching hospitals (n=1770) and one university hospital (n=80). Patients were referred from almost all specialisms (surgical and medical patients representing the largest proportion), details of which have been published previously (7). All patients 18 years and older who visited the outpatient department on one of the screening days were included in the study.

Multicenter approval was given by the ethical review board of the VU University Medical Center. Because of the low subject burden and the fact that data were handled and stored anonymously, informed consent was not considered necessary by the ethical review board.

Nutritional status

Patients were asked to fill out the questionnaires themselves after registration to the outpatient clinic. The study questionnaire consisted of questions on age, sex, recent unintentional weight loss (one and six months) and the individual items of both MUST (14) and SNAQ (15). The individual items of the screening tools are presented in **Table 1**.

Height and weight were measured by trained research assistants. Details regarding the measurements have been previously reported (7). Patients were weighed wearing indoor clothing without shoes. An adjustment for clothing was made by deducting 1.77 kg for men and 1.13 kg for women from their measured weight (16). An additional correction of 0.40 kg for men and 0.28 kg for women was made when patients were unable to take off their shoes (16). Nutritional status was based on the self-reported unintentional weight loss and measured body mass index (BMI). Patients were either classified as (17-20):

- severely undernourished; BMI $< 18.5 \text{ kg/m}^2$ (age < 65 years) or $< 20 \text{ kg/m}^2$ (age ≥ 65 years), or unintentional weight loss of more than 5% in the last month or more than 10% in the last six months;
- moderately undernourished; BMI $18.5\text{-}20 \text{ kg/m}^2$ (age < 65) or BMI $20\text{-}22 \text{ kg/m}^2$ (age ≥ 65) or 5-10% unintentional weight loss in the last six months;
- not undernourished; BMI $> 20 \text{ kg/m}^2$ (age < 65) or BMI $> 22 \text{ kg/m}^2$ (age ≥ 65) and $< 5\%$ unintentional weight loss in the last six months.

Diagnostic accuracy

The MUST and SNAQ screening tools were validated against the abovementioned definition based on unintentional weight loss and BMI. Nutritional status according to the objective definition and according to both screening tools was subdivided into three categories; not undernourished (MUST = 0, SNAQ \leq 1), moderately undernourished (MUST = 1 ('medium risk'); SNAQ = 2) and severely undernourished (MUST \geq 2 ('high risk'); SNAQ \geq 3). Diagnostic accuracy was assessed for identifying severely undernourished patients (MUST \geq 2; SNAQ \geq 3) and for identifying both moderate and severely undernourished patients (MUST \geq 1; SNAQ \geq 2). Because of different BMI cut-off points to determine undernutrition in older individuals, the diagnostic values were determined for the total population, and for patients aged < 65 years and those aged \geq 65 years separately.

Diagnostic accuracy was expressed as sensitivity (Se), specificity (Sp), positive predictive value (PPV) and negative predictive value (NPV). We considered the diagnostic values to be (un)acceptable according to the following cut-off points: 90-100% excellent; 80-90% good; 70-80% fair; 60-70% insufficient; <60% poor. Our main focus is the validity of the screening tools in identifying severely undernourished patients, as these are the patients in need of dietetic treatment.

Statistics

Descriptive statistics were used to express means, standard deviations, percentages and frequencies. Cross-tabulations were used to establish diagnostic accuracy in terms of sensitivity, specificity, positive and negative predictive values. Clopper-Pearson intervals were used to express 95% confidence intervals. Statistical analyses were performed in SPSS 20.0 for Windows (IBM) and StatXact 4.0.1 for Windows (Cytel Software Corporation, Cambridge, MA, USA).

Results

A total of 2584 patients filled out the questionnaire. Of these, 296 patients (11%) were excluded because nutritional status could not be defined due to missing data on measured height and/or weight. Another 52 patients were excluded because scores on the screening tools could not be calculated due to missing data on one or more items of the screening tools (**Figure 1**). Hence, the total study sample consisted of 2236 patients (52.4% female) with a mean age of 56.6 (SD 16.3) years.

Characteristics of the outpatient sample are presented in **Table 1**. According to the definition based on BMI and weight loss, 6% was severely undernourished and 7% was

moderately undernourished. Sex ($p<0.01$), percentage of patients ≥ 65 years ($p=0.04$) and mean BMI ($p<0.01$) statistically significant differed between the three nutritional status categories.

Based on MUST, 209 patients (9.3%) were identified severely undernourished and 128 patients (5.7%) were identified moderately undernourished. Based on SNAQ, 74 patients (3.3%) were identified severely undernourished and 42 patients (1.9%) were identified moderately undernourished (**Table 1**).

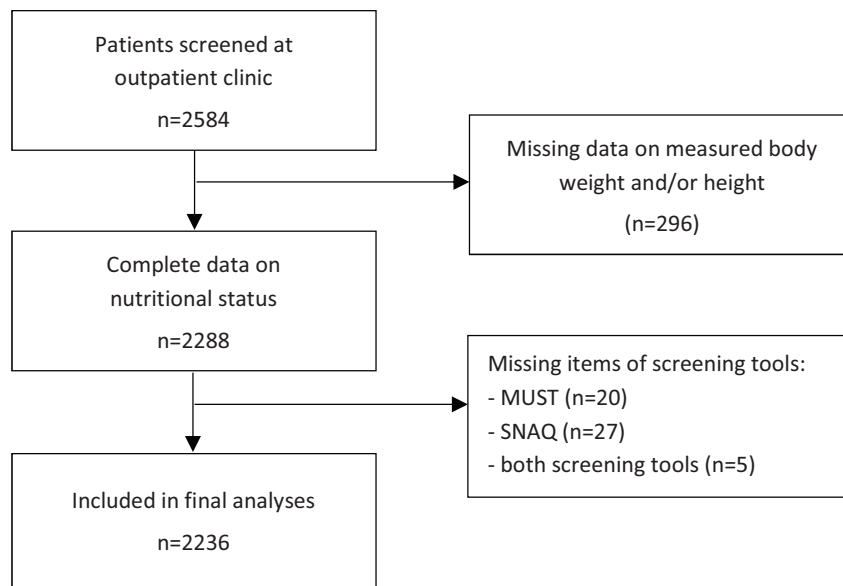


Figure 1. Flowchart.

Table 1. Characteristics of the Dutch hospital outpatient sample divided by nutritional status according to the objective definition (n=2236).

		Severely undernourished	Moderately undernourished	Not undernourished
n (%)		134 (6.0%)	155 (6.9%)	1947 (87.1%)
Sex, % women		53.7%	61.9%	51.5%
Age in years (\pm SD)		59.5 \pm 20.4	56.7 \pm 18.9	56.4 \pm 15.7
Age \geq 65 years		67 (50.0%)	68 (43.9%)	645 (33.1%)
BMI in kg/m ² (\pm SD)		20.7 \pm 4.0	21.4 \pm 3.0	27.3 \pm 4.8
BMI < 18.5 (< 65 years)		37 (27.6%)	-	-
BMI < 20 (\geq 65 years)		37 (27.6%)	-	-
>10% weight loss in 6 months n (%)		47 (35.1%)	-	-
>5% weight loss in 1 month n (%)		47 (35.1%)	-	-
SNAQ				
Weight loss > 6 kg in 6 months	(=3 pts)	49 (36.6%)	13 (8.4%)	0
Weight loss > 3 kg in 1 month	(=2 pts)	60 (44.8%)	3 (1.9%)	2 (0.5%)
Decreased appetite last month	(=1 pt)	60 (44.8%)	42 (27.1%)	248 (12.7%)
Use of sip/tube feed last month	(=1 pt)	25 (18.7%)	6 (3.9%)	49 (2.5%)
SNAQ score (0- points)				
0-1 no undernutrition		63 (47.0%)	142 (91.6%)	1915 (98.4%)
2 moderate undernutrition		13 (9.7%)	0	29 (1.5%)
\geq 3 severe undernutrition		58 (43.3%)	13 (8.4%)	3 (0.2%)
MUST				
BMI				
> 20	(=0 pts)	56 (41.8%)	89 (57.4%)	1947 (100%)
18.5 – 20	(=1 pt)	28 (20.9%)	66 (42.6%)	0
< 18.5	(=2pts)	50 (37.3%)	0	0
% Weight loss 3-6 months				
< 5%	(=0 pts)	65 (48.5%)	109 (70.3%)	1947 (100%)
5 – 10%	(=1 pt)	22 (16.4%)	46 (29.7%)	0
> 10%	(=2pts)	47 (35.1%)	0	0
Acute disease effect score	(=2 pts)	29 (21.6%)	4 (2.6%)	99 (5.1%)
MUST score (0-6 points)				
0 low risk		3 (2.2%)	48 (31.0%)	1848 (94.9%)
1 medium risk		30 (22.4%)	98 (63.2%)	0
\geq 2 high risk		101 (75.4%)	9 (5.8%)	99 (5.1%)

BMI, Body Mass Index; SNAQ, Short Nutritional Assessment Questionnaire; MUST, Malnutrition Universal Screening Tool.

The diagnostic accuracy of both screening tools is presented in **Table 2**. These results demonstrate that $MUST \geq 2$ ('high risk') showed an overall low positive predictive value (43-59%) and a low sensitivity for older individuals (58%). Other diagnostic values were fair to excellent. For $MUST \geq 1$ ('medium and high risk') positive predictive values were 68-76% and sensitivity was 82% for the total sample and 64% for patients aged ≥ 65 years. $SNAQ \geq 3$ (severely undernourished) showed an overall low sensitivity (42-45%), although other diagnostic values were fair to excellent. Combining the moderately and severely undernourished patients ($SNAQ \geq 2$) resulted in sensitivities of 27-31%.

Table 2. Diagnostic accuracy (95% CI) of MUST and SNAQ in the total sample of hospital outpatients and stratified by age group.

	Sensitivity (95% CI)	Specificity (95% CI)	Positive predictive value (95% CI)	Negative predictive value (95% CI)
<i>MUST ≥ 2 points</i>				
all patients	75 (67-82)	94 (94-96)	48 (41-55)	98 (98-99)
patients < 65 years	93 (83-98)	94 (93-95)	43 (35-52)	100 (99-100)
patients ≥ 65 years	58 (46-70)	96 (95-97)	59 (46-71)	96 (94-97)
<i>MUST ≥ 1 point</i>				
all patients	82 (77-87)	95 (94-96)	71 (65-75)	97 (96-98)
patients < 65 years	99 (95-100)	94 (93-96)	68 (61-74)	100 (99-100)
patients ≥ 65 years	64 (55-72)	96 (94-97)	76 (67-84)	93 (90-95)
<i>SNAQ ≥ 3 points</i>				
all patients	43 (35-52)	99 (99-100)	78 (67-87)	96 (96-97)
patients < 65 years	45 (33-57)	99 (99-100)	81 (65-92)	97 (96-98)
patients ≥ 65 years	42 (30-54)	99 (98-99)	76 (59-88)	95 (93-96)
<i>SNAQ ≥ 2 points</i>				
all patients	29 (24-35)	98 (98-99)	72 (63-80)	90 (89-92)
patients < 65 years	27 (20-35)	98 (97-99)	66 (53-77)	92 (90-93)
patients ≥ 65 years	31 (23-40)	98 (97-99)	81 (67-90)	87 (85-90)

CI, Confidence Interval; MUST, Malnutrition Universal Screening Tool; SNAQ, Short Nutritional Assessment Questionnaire.

Discussion

The purpose of this study was to determine the validity of MUST and SNAQ for undernutrition screening in a large, heterogeneous sample of hospital outpatients. After comparing both screening tools against our objective definition of undernutrition, the validity of MUST and SNAQ turned out to be insufficient for hospital outpatients. While the SNAQ had a poor sensitivity, thereby identifying too few patients as undernourished, the MUST had a poor positive predictive value, identifying too many patients as undernourished, as well as a poor sensitivity for older individuals.

The poor positive predictive value of the MUST is likely due to the 'acute disease effect score'. Patients with a normal BMI and no history of weight loss were screened as severely undernourished when they report to be acutely ill and when there is (likely to be) no nutritional intake for > 5 days (14). Whilst hospital outpatients may be unlikely to apply to this criterion (21), 132 patients responded positively to the question about acute disease effect, resulting in a MUST score of 2 points and thus indicating severe undernutrition. However, of these only 29 patients (22%) were in fact severely undernourished based on the objective definition. Overestimation of undernutrition would increase the number of incorrect referrals to a dietician and thus, unnecessarily increase their workload. Because proper treatment of undernourished outpatients requires further nutritional assessment and consult time is limited, we believe that it is unfavourable to implement a screening tool with low positive predictive value.

The poor sensitivity of MUST for older patients could at least be partly explained by the difference in BMI cut-off points to assess undernutrition. MUST uses BMI < 18.5 kg/m² to define undernutrition for all patients, while in our definition of undernutrition we used a BMI < 20 kg/m² for patients aged ≥ 65 years.

The poor sensitivity of SNAQ can be most likely explained by the large number of patients who were classified as undernourished based on a low BMI. SNAQ was originally developed for hospital inpatients, in whom unintentional weight loss due to acute illness is more prevalent than a low BMI. As the SNAQ is a quick-and-easy screening tool in which BMI is not included, the tool is likely to miss patients with a low BMI (15). Forty-six percent of undernourished patients in our sample were classified as undernourished due to low BMI in the absence of weight loss.

We post-hoc combined SNAQ with measured BMI, using the following cut-off points: for patients < 65 years old: BMI < 18.5 = 3 points; 18.5-20 = 2 points; > 20 = 0 points. For patients ≥ 65 years old: BMI < 20 = 3 points; 20-22 = 2 points; > 22 = 0 points. This increased the diagnostic values significantly (sensitivity: 95% (90-98); specificity: 99% (99-100); positive predictive value: 89% (82-93); negative predictive value: 100% (99-100)).

However, this very much resembles the used gold standard and can hardly be considered a screening tool.

An important finding within the analysis of the SNAQ, was the high prevalence of patients reporting on decreased appetite. In severely undernourished patients, the prevalence of decreased appetite was just as high as the prevalence of reported weight loss, while in moderately and not undernourished patients decreased appetite was the vastly most reported of all four screening questions. It is important to realize that decreased appetite is not the same as low intake. Even though patients could experience a decreased appetite, some still manage to obtain sufficient protein and energy. However, health care professionals should be extra aware of the risk of undernutrition in patients reporting decreased appetite.

To our knowledge, this is the first large-scale study to assess the validity of MUST and SNAQ in hospital outpatients. A major strength is that we used a large, multicenter sample with patients from nine different hospitals across the Netherlands and covering 23 different outpatient departments (7).

Some limitations of the study should also be acknowledged. The individual questions of both MUST and SNAQ were integrated in the general research questionnaire which patients received at admission to the outpatient clinic. Consequently, patients answered the questions of the screening tools themselves. As both screening tools were originally developed to be carried out by a health care worker, this may have biased our results. Especially acute disease effect may have been broadly overestimated by self-report. On the other hand, our study design better reflects daily practice, as in several outpatient departments patients are filling out the nutritional screening form ('self-screening') because of limited consultation time. Cawood et al. recently assessed the validity of self-screening with the MUST in hospital outpatients (21). Good agreement was shown between self-screening and screening by a health care professional. We believe that self-screening or assessment could be beneficial in this health care setting, but more research is warranted.

A second limitation is the absence of a generally accepted gold standard. This is a point of discussion in every study on disease-related undernutrition (22) and is of major importance in validation studies. In this study, we applied a commonly used and acknowledged definition based on a combination percentage of unintentional weight loss and objectively measured BMI (18;22), to indicate both acute undernutrition (weight loss) and chronic undernutrition (low BMI).

A final limitation is that we examined only two screening tools as they are applied to hospital patients in The Netherlands. It would be worthwhile to assess the diagnostic accuracy of other internationally used undernutrition screening tools, such as NRS-2002 (13), and MST (11). Moreover, the MNA-SF (12) and the recently developed SNAQ⁶⁵⁺ (23) might be applicable screening tools for older hospital outpatients, and the validity of these tools should be considered in future studies.

Since hospitals increasingly introduce electronic patient records, we advise a frequent (e.g. at least at each first outpatient visit) registration of measured height and weight. The calculation of BMI and previous weight loss can be easily programmed. Our study shows that this objective information may be crucial to determine undernutrition in hospital outpatients as the previously developed screening tools MUST and SNAQ were found not to be valid in this study.

Conclusion

This study concludes that the MUST and SNAQ nutritional screening tools are not valid to assess undernutrition in a heterogeneous group of hospital outpatients. We advise to measure body weight, height and enquire weight loss to determine undernutrition in hospital outpatients.

References

1. Meijers JM, Halfens RJ, van Bokhorst-de van der Schueren MA, Dassen T, Schols JM. Malnutrition in Dutch health care: Prevalence, prevention, treatment, and quality indicators. *Nutrition* 2009;25:512-9.
2. Norman K, Pichard C, Lochs H, Pirlich M. Prognostic impact of disease-related malnutrition. *Clin Nutr* 2008;27:5-15.
3. Kruizenga HM, de Jonge P, Seidell JC et al. Are malnourished patients complex patients? Health status and care complexity of malnourished patients detected by the Short Nutritional Assessment Questionnaire (SNAQ). *Eur J Intern Med* 2006;17:189-94.
4. Kyle UG, Pirlich M, Lochs H, Schuetz T, Pichard C. Increased length of hospital stay in underweight and overweight patients at hospital admission: a controlled population study. *Clin Nutr* 2005;24:133-42.
5. Green CJ. Existence, causes and consequences of disease related malnutrition in the hospital and the community, and clinical and financial benefits of nutritional intervention. *Clin Nutr* 1999;18:3-28.
6. Correia MI, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. *Clin Nutr* 2003;22:235-9.
7. Leistra E, Neelemaat F, Evers AM et al. Prevalence of undernutrition in Dutch hospital outpatients. *Eur J Intern Med* 2009;20:509-13.
8. Neelemaat F, Kruizenga HM, De Vet HCW, Seidell JC, Buttermann M, Bokhorst-de van der Schueren MAE. Malnutrition screening in hospital outpatients. Can the SNAQ malnutrition screening tool also be applied in this population? *Clin Nutr* 2008;27:439-46.
9. Wilson MM, Vaswani S, Liu D, Morley JE, Miller DK. Prevalence and causes of undernutrition in medical outpatients. *Am J Med* 1998;104:56-63.
10. Centraal Bureau voor de Statistiek. Gezondheid en zorg in cijfers 2009. Den Haag/Heerlen; 2009.
11. Ferguson M, Capra S, Bauer J, Banks M. Development of a valid and reliable malnutrition screening tool for adult acute hospital patients. *Nutrition* 1999;15:458-64.
12. Rubenstein LZ, Harker JO, Salva A, Guigoz Y, Vellas B. Screening for undernutrition in geriatric practice: developing the short-form mini-nutritional assessment (MNA-SF). *J Gerontol A Biol Sci Med Sci* 2001;56:M366-M372.
13. Kondrup J, Rasmussen HH, Hamberg O, Stanga Z. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials. *Clin Nutr* 2003;22:321-36.
14. Stratton RJ, Hackston A, Longmore D et al. Malnutrition in hospital outpatients and inpatients: prevalence, concurrent validity and ease of use of the 'malnutrition universal screening tool' ('MUST') for adults. *Br J Nutr* 2004;92:799-808.
15. Kruizenga HM, Seidell JC, de Vet HC, Wierdsma NJ, van Bokhorst-de van der Schueren MA. Development and validation of a hospital screening tool for malnutrition: the short nutritional assessment questionnaire (SNAQ). *Clin Nutr* 2005;24:75-82.
16. Frank E, Dunlop AL. What does a patient's outfit weigh? *Fam Med* 2000;32:595-6.

17. Detsky AS, Smalley PS, Chang J. Is this patient malnourished? JAMA 1994;271:54-8.
18. Stratton RJ, Green CJ, Elia M. Disease related malnutrition: an evidence-based approach to treatment. 1 ed. Cambridge: CABI Publishing 2003:1-34.
19. Kruizenga HM, de Vet HC, Van Marissing CM et al. The SNAQRC, an Easy Traffic Light System as a First Step in the Recognition of Undernutrition in Residential Care. J Nutr Health Aging 2010;14:83-9.
20. Sergi G, Perissinotto E, Pisent C et al. An adequate threshold for body mass index to detect underweight condition in elderly persons: the Italian Longitudinal Study on Aging (ILSA). J Gerontol A Biol Sci Med Sci 2005;60:866-71.
21. Cawood AL, Elia M, Sharp SK, Stratton RJ. Malnutrition self-screening by using MUST in hospital outpatients: validity, reliability, and ease of use. Am J Clin Nutr 2012;96:1000-7.
22. Meijers JM, van Bokhorst-de van der Schueren MA, Schols JM, Soeters PB, Halfens RJ. Defining malnutrition: mission or mission impossible? Nutrition 2010;26:432-40.
23. Wijnhoven HA, Schilp J, van Bokhorst-de van der Schueren MA et al. Development and validation of criteria for determining undernutrition in community-dwelling older men and women: The Short Nutritional Assessment Questionnaire 65+. Clin Nutr 2011;31:351-8.



Chapter 6

Effect of early individualized dietary counseling on weight loss, complications and length of hospital stay in patients with head and neck cancer; a comparative study



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Abstract

Background: We assessed the effect of early individualized dietary counseling (DC) on weight loss, complications and length of hospital stay (LOS) in patients with head and neck cancer (HNC).

Methods: 95 newly diagnosed HNC patients with (risk of) undernutrition receiving DC were compared to 95 matched HNC patients receiving usual nutritional care (UC). Difference in weight change over time was analyzed by GEE. Differences in complications and LOS were studied by Pearson chi-squared and student's t-tests.

Results: Weight change between diagnosis and end of treatment was $-6.0 \pm 6.9\%$ (DC) and $-5.4 \pm 5.7\%$ (UC) (GEE: -0.4kg , 95%CI: -1.2 to 0.5 ; $p=0.44$). Less DC patients experienced minor postoperative complications (44%/70%, $p=0.04$). No effect on other complications or LOS was found.

Conclusions: This study showed a lower prevalence of minor postoperative complications in HNC patients receiving DC, but could not demonstrate an effect on weight loss, other complications, and LOS.

Introduction

Over the past decades, the recognition of disease-related undernutrition in hospitalized patients has improved in the Netherlands (1). Currently, nutritional screening is shifting towards the outpatient setting; earlier recognition of undernutrition creates the opportunity to improve a patient's nutritional status before the actual start of medical treatment. From previous research we know that the prevalence of undernutrition in outpatient departments is highest at the departments of oral maxillofacial surgery (17%) and oncology (16%) (2). This emphasizes that patients with head and neck cancer (HNC) are an important group to focus on.

HNC patients are at risk for undernutrition due to complaints induced by the tumor-localization, causing dysphagia, odynophagia, and/or oral pain (3-5). In addition, metabolic alterations induced by the tumor may result in changes in taste and appetite (6-9). Weight loss is one of the main symptoms of undernutrition. Due to these tumor-induced problems with oral intake, (critical) weight loss is observed in 3-52% of HNC patients before they start medical treatment (10-14). During treatment, weight often continues to decline due to treatment related side effects which hamper food intake even further, such as xerostomia, dysphagia, mucositis, and anorexia (6;8;15). Undernutrition is associated with loss of muscle function (16;17), impaired immune function (18), increased risk of postoperative complications (19-21), longer hospitalization(22), reduced quality of life (10;23-25), and increased mortality (26-28). Preventing decline in nutritional status prior to treatment could be a potential way to reduce these negative consequences.

A recent systematic review showed that individualized dietary counseling has positive effects on nutritional status and quality of life in HNC patients during radiotherapy when compared to no counseling or standard nutritional advice by a nurse (29). Yet, the effects of dietary counseling initiated at time of diagnosis are currently unknown.

Therefore, the aim of this study was to assess the effect of early individualized dietary counseling (initiated at the first outpatient visit) in patients with head and neck cancer on weight loss, major complications and length of hospital stay.

Materials and methods

Study design

This study was designed as an intervention study evaluating the effect of early individualized dietary counseling (DC) compared to usual nutritional care (UC) in patients with HNC in terms of weight loss, complications and length of hospital stay. Patients were

treated with either radiotherapy (RT), chemoradiotherapy (CRT), or surgery (combined Mandibular Resection (COMMANDO), Total Laryngectomy (TLE) or Transoral Excision (TOE)). Timing of data collection is described in **Figure 1**, in which T0 describes first outpatient visit, T1 describes start of primary anti-tumor treatment, and T2 describes end of primary anti-tumor treatment (surgery: at hospital discharge; (C)RT: 12 weeks after the start of treatment).

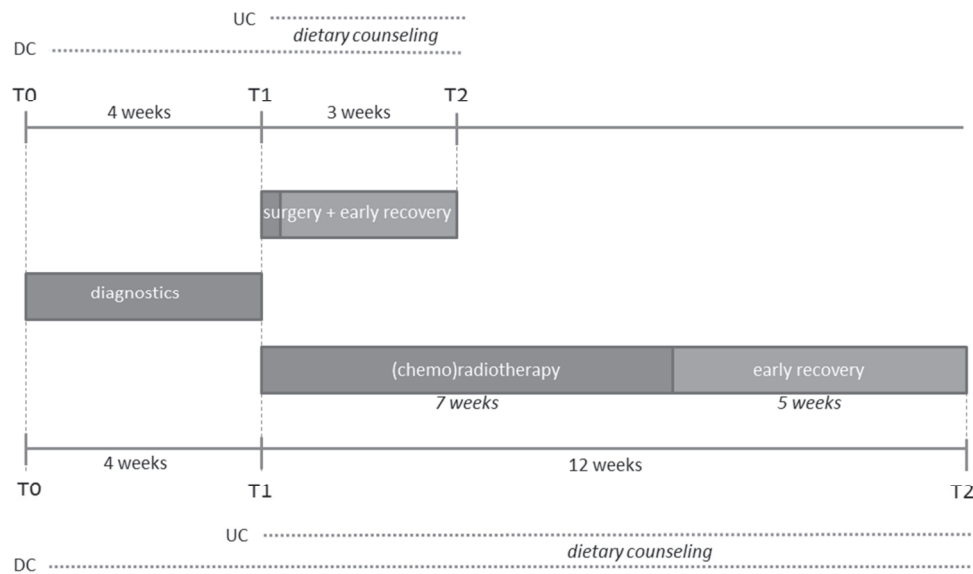


Figure 1. Data collection on body weight for HNC patients undergoing surgery and (chemo) radiotherapy.

T0, first outpatient visit; T1, start of primary anti-tumor treatment; T2, end of primary anti-tumor treatment; DC, Individualized Dietary Counseling; UC, Usual Care.

Study population

This study was part of a project to improve patient care at the outpatient department of Otolaryngology/Head & Neck Surgery of the VU University Medical Centre. As of July 2011, in all newly diagnosed HNC patients height, weight, weight history and oral symptoms were determined by outpatient nurses. All consecutive patients received early individualized dietary counseling (DC) if they met the following criteria: age 18 years or older; newly diagnosed with a malignant tumor in the head and neck area (oral cavity, pharynx, larynx, nasal cavity); treatment with curative intent; body mass index (BMI) <20

kg/m² (<65 years) or <22 kg/m² (≥65 years), and/or reported unintentional weight loss ≥5% in the last six months, and/or experienced oral symptoms (dysphagia, chewing problems, or passage problems). Patients with benign tumors, undergoing palliative treatment, minor surgery during microlaryngoscopy (e.g. CO₂ laser), or patients not able to understand the dietary advice due to language barriers or cognitive impairment, were excluded. The study was approved by the ethical review board of the VU University Medical Center. As the study was part of a care improvement program, no written informed consent was obtained from patients.

A control group was drawn from a historical cohort of newly diagnosed HNC patients who visited the outpatient department of Otolaryngology/Head & Neck Surgery of the VUmc between June 2007 and June 2011. Patients were one-to-one matched for the following baseline characteristics; tumor location (oral cavity, oropharynx, nasopharynx, hypopharynx, larynx, nasal cavity), TNM tumor stage (I-IV), primary treatment (radiotherapy, chemoradiotherapy, surgery), nutritional screening outcome within 1 week after first outpatient visit (combination of Short Nutritional Assessment Questionnaire (SNAQ) and BMI (30;31)), sex, and age. Matching was performed blind for any outcome parameter.

Nutritional screening

In both DC and UC patients, nutritional screening was performed by a senior nurse at T0 (during or within 1 week after first outpatient visit) using the Short Nutrition Assessment Questionnaire (SNAQ) (30). As we recently demonstrated that SNAQ alone is an insufficient tool in detecting undernutrition in the outpatient setting, we used a combination of SNAQ screening outcome and BMI to determine nutritional status (31). Patients were classified as severely undernourished when SNAQ ≥ 3 and/or BMI <18.5 kg/m² (<65 years) or <20 kg/m² (≥65 years); moderately undernourished when SNAQ = 2 and/or BMI ranged from 18.5 to 20 kg/m² (<65 years) or from 20 to 22 kg/m² (≥65 years); and not undernourished when SNAQ ≤ 1 and BMI >20 kg/m² (<65 years) or >22 kg/m² (≥65 years) (30-32).

Individualized dietary counseling (DC)

DC patients were consulted by a dietician within one week after their first outpatient visit. Dietary counseling was provided according to the most recent Dutch guidelines (33;34), and aimed to optimize or maintain nutritional status (35).

Dietary assessment consisted of a dietary recall to determine current intake of energy, nutrients, and alcohol; an evaluation of oral symptoms affecting nutritional intake, including the shortened questionnaire on Functional Assessment of Anorexia/Cachexia Therapy (FAACT A/CS12) (36); and a complete nutritional assessment, including the measurement of weight, fat-free mass (index) measured with multi-frequency BIA, handgrip strength and mid-upper arm (muscle) circumference. Accordingly, the dietician designed an individualized dietary advice aiming to achieve a recommended protein intake of at least 1.2-1.5 gram per kg body weight, and a recommended energy intake according to the Harris Benedict equation (37) with an individual surcharge for disease and activity (38;39).

The individualized dietary advice initially focused on improving dietary patterns with normal food intake, protein- and/or energy enrichment, modified texture in patients with dysphagia, and alleviation of oral symptoms in patients with oral pain or chewing problems. If patients did not meet their goals with normal food, oral nutritional supplements (ONS) and/or tube feeding were provided. Next to oral advice, all patients received written information, including general nutritional advice for HNC patients, advice on protein- and/or energy-enriched diet, and information on ONS or tube feeding if applicable.

In the (approximately) 4 weeks between first outpatient visit (T0) and start of anti-tumor treatment (T1), the dietician consulted the patients weekly by telephone or face-to-face during outpatient or diagnostic hospital visits. Consultation involved evaluation of weight, nutritional intake and oral symptoms, and the dietician gave additional advice or adjusted the treatment strategy when necessary.

Usual care (UC)

The difference between DC and UC was related to timing of dietary treatment. Whereas DC patients were offered the abovementioned dietary treatment regimen in the pre-treatment period, in UC patients, in general, dietary treatment was initiated at start of antitumor treatment (**Figure 1**). In the UC group, patients were prescribed ONS (standard of 4 packages a day) by the nurse in case of a SNAQ score ≥ 3 or severe swallowing problems. UC patients were consulted by a dietician before start of treatment (T0-T1) only on referral by a physician.

During anti-tumor treatment (T1-T2), all patients (DC and UC) received protocolized dietary counseling by a dietician; weekly until discharge in patients undergoing surgery, and in weeks 1, 3, 5, 6, 7, 9, 12 in patients undergoing (chemo)radiotherapy. Frequency of

dietary consultations increased when more problems occurred. Patients undergoing chemoradiotherapy underwent prophylactic percutaneous endoscopic gastrostomy (PEG) placement prior to start of CRT treatment in both DC and UC groups. Tube feeding was started in case of continuing low intake.

Outcome variables

Three outcome parameters were compared between DC and UC: weight change, major postoperative and (chemo)radiotherapy-induced complications, and length of hospital stay. Data on outcome variables were retrieved from medical records, except for body weight in the DC group.

Weight change

Data on body weight were collected at first outpatient visit (T0), start of primary treatment (T1), and end of primary treatment (T2). In DC patients, body weight and height were measured. Height was measured to the nearest 0.5 cm using a stadiometer (Seca 222, Seca Medical Scales & Measuring Systems, Birmingham, UK) with the patients standing barefoot. In patients who were unable to stand, height was retrieved from self-reported height. Weight was measured to the nearest 0.1 kg using a calibrated electronic scale (Seca 888, Seca Medical Scales & Measuring Systems, Birmingham, UK). Patients were wearing light indoor clothes without shoes. A correction factor of -1.6 and -1.0 kg for clothes was used in men and women respectively (40). Furthermore, a correction factor of -0.4 and -0.3 kg was used in men and women respectively, when patients were unable to take off their shoes (40). In UC patients, data on height and weight were obtained from medical records and corrected for clothes and shoes when applicable.

Complications

Data on postoperative complications were systematically obtained from surgical reports, clinical patient records, and discharge letters. Patients were dichotomously classified as having a certain complication or not. Major postoperative complications included malaise-related readmissions within 4 weeks after hospital discharge, reoperation due to wound healing problems or reoperation for fistula, admission to the Intensive Care Unit (ICU), and in-hospital mortality and were all robust and well-documented in medical records. Minor complications included all other complications leading to a complicated postoperative course, with special regard to postoperative aspiration pneumonia, wound infections, and fistulas. It was generally well-documented in discharge letters whether (and why) the postoperative course was complicated. Surgical reports and clinical patient records were

also checked to verify minor complications. All surgical complications obtained from medical records were discussed with the head and neck surgeon (SE).

Data on (chemo)radiotherapy complications were obtained from radiotherapy records, clinical patient records (if applicable), and discharge letters. In patients undergoing (chemo)radiotherapy, major complications were determined as unplanned hospital admissions during treatment, and postponement of chemotherapy. In addition, severe acute toxicity was assessed according to the Common Terminology Criteria for Adverse Events (CTCAEv3.0) as determined by the radiotherapist; mucositis \geq grade 3, dysphagia \geq grade 3 and xerostomia \geq grade 2 during week 4-8 of (C)RT treatment were compared between DC and UC groups. In our center, assessment of CTCAE radiotherapy toxicity scores was introduced in 1997. For head and neck cancer patients undergoing radiotherapy, these scores are documented according to protocol; weekly during radiation for 8 weeks and at regular intervals thereafter (41).

Length of hospital stay

In patients undergoing surgery, length of hospital stay was recorded. Length of hospital stay is presented for the total surgical group and differentiated for type of surgery.

Statistical analysis

Comparisons between the DC and UC group were carried out on an intention-to-treat basis, whereby DC patients were analyzed in the DC group, regardless whether they had participated in all dietary consultations.

Baseline characteristics of the DC and UC group were described using means \pm standard deviations (SD) for continuous variables, and frequencies and proportions for dichotomous and categorical variables.

Differences in body weight change over time between the DC and UC group were analyzed using Generalized Estimating Equations (GEE) with an exchangeable correlation structure, corrected for T0 weight and number of days between measurements to correct for individual variation and the differences in time span between surgery and (C)RT treatment period. Difference in weight change over time was assessed for all patients, and for subgroups based on treatment (surgery, (C)RT) and nutritional status at baseline (no undernutrition, moderate undernutrition, severe undernutrition).

Differences in complications were compared with Pearson chi-squared tests. Differences in length of hospital stay were tested with independent student's t-tests.

All analyses were performed using SPSS 20.0 for Windows (IBM corporation, Armonk, NY, USA). P-values of <0.05 were considered as statistically significant.

Results

Table 1 summarizes baseline (T0) characteristics of the DC and the UC group. Groups were comparable for all baseline characteristics, except for body weight at T0. DC patients had significantly lower body weight at diagnosis compared to UC patients (67.9 ± 14.1 vs. 72.3 ± 15.9 kg; $p=0.04$), however groups were not significantly different for BMI (23.7 ± 4.7 vs. 22.7 ± 4.4 kg/m²; $p=0.14$). Twenty-one percent (DC) and 19% (UC) of patients were scheduled for radiotherapy, 43% (DC) and 45% (UC) underwent chemoradiotherapy and 36% (both groups) underwent surgery as primary treatment.

Three DC patients never started the scheduled curative intended treatment; 2 rejected their curative intended treatment (both RT), and 1 died before start of treatment (CRT). No follow-up data are available for these patients. All UC patients started the scheduled treatment.

The mean period between diagnosis and start of primary anti-tumor treatment was on average 29 ± 9 days in the DC group and 33 ± 11 days in the UC group ($p<0.01$). Out of the 95 DC patients, 79 were consulted by a dietician at their first visit to the outpatient department of Otolaryngology/Head & Neck Surgery, and 16 were first consulted within 1 week after this outpatient visit. One patient (RT) refused any dietary counseling after the first consultation, all other DC patients were consulted more than once between diagnosis and start of treatment. Between T0 and T1, 32 patients were prescribed ONS, and one patient was prescribed tube feeding.

Out of the 95 UC patients, 72 were screened for undernutrition at diagnosis, and 23 were screened within 1 week after diagnosis. In the UC group, 26 patients (27%) were referred to a dietician for at least one consultation between T0 and T1.

Prior to (C)RT treatment, prophylactic percutaneous endoscopic gastrostomy (PEG) placement was performed in 39 DC and 36 UC patients.

Table 1. Baseline characteristics of HNC patients receiving Early Individualized Dietary Counseling (DC) or Usual Care (UC).

	DC (n=95)		UC (n=95)		p-value
	n	(%)	n	(%)	
Sex					0.52
Male	65	(68)	69	(73)	
Female	30	(32)	26	(27)	
Age ^a	62.2 ± 10.0		60.5 ± 9.8		0.23
Weight ^a	67.9 ± 14.1		72.3 ± 15.9		0.04
Height ^a	172.8 ± 9.3		174.6 ± 8.9		0.18
BMI ^a	23.7 ± 4.7		22.7 ± 4.4		0.14
Low BMI ^b	17	(18)	12	(13)	0.31
Tumor location					0.99
Oral cavity	28	(29)	28	(29)	
Oropharynx	32	(34)	32	(34)	
Nasopharynx	1	(1)	2	(2)	
Hypopharynx	10	(11)	10	(11)	
Larynx	20	(21)	20	(21)	
Nasal cavity	4	(4)	3	(3)	
TNM stage					0.78
Stage I	7	(7)	5	(5)	
Stage II	9	(10)	13	(14)	
Stage III	21	(22)	21	(22)	
Stage IV	58	(61)	56	(59)	
Nutritional status					0.71
No undernutrition	40	(42)	45	(47)	
Moderate undernutrition	15	(16)	12	(13)	
Severe undernutrition	40	(42)	38	(40)	
Primary anti-tumor treatment					0.93
Radiotherapy	20	(21)	18	(19)	
Chemoradiotherapy	41	(43)	43	(45)	
Surgery	34	(36)	34	(36)	
COMMANDO	10	(11)	10	(11)	
TLE	11	(12)	11	(12)	
TOE	13	(14)	13	(14)	

COMMANDO, Combined Mandibular Resection; TLE, Total Laryngectomy; TOE, Transoral Excision.

^a mean ± SD; ^b Low BMI; <18.5 kg/m² (<65 years) or <20 kg/m² (≥65 years).

Weight change

In both groups, body weight declined during the course of treatment (**Figure 2**). On average, DC patients experienced -0.7% ($\pm 5.5\%$) weight loss and UC patients experienced -0.2% ($\pm 3.5\%$) weight loss between T0 and T1 ($p=0.53$). Only patients with moderate undernutrition at baseline gained weight between T0-T1 in both groups ($2.4\% \pm 5.5\%$ vs. 0.5 ± 1.8 ; $p=0.25$). Between T0 and T2, DC patients experienced -6.0% ($\pm 6.9\%$) weight loss and UC patients experienced -5.4% ($\pm 5.7\%$) weight loss ($p=0.83$). When corrected for baseline weight and number of days between measurements, no significant treatment effect for weight change was observed between DC and UC patients; the estimated difference in weight change between the groups on average over time was 0.4 lower for DC compared to UC (95% CI: $-1.2 - 0.5$; $p=0.44$). Also for the subgroup analyses for treatment or nutritional status at baseline no significant differences were found (**Table 2**).

Table 2. Overall treatment effect of Early Individualized Dietary Counseling (DC) or Usual Care (UC) on changes in body weight over time for all patients and subgroups based on primary treatment and nutritional status at T0. ^a

	β	95% CI	<i>p</i> -value
All patients ($n=95$)	-0.4	-1.2 ; 0.5	0.44
According to primary treatment:			
Surgery ($n=34$)	0.5	-0.8 ; 1.9	0.43
(C)RT ($n=61$)	-0.9	-2.0 ; 0.3	0.13
According to baseline nutritional status:			
No undernutrition ($n=40$ vs. $n=45$)	-0.5	-1.9 ; 0.9	0.48
Moderate undernutrition ($n=15$ vs. $n=12$)	-1.0	-2.9 ; 1.0	0.32
Severe undernutrition ($n=40$ vs. $n=38$)	0.2	-1.1 ; 1.5	0.81

^a β (and *p*-value) represents the overall treatment effect on body weight over time, derived from Generalized Estimating Equation (GEE) with an exchangeable correlation structure, adjusted for T0 weight and number of days until measurement.

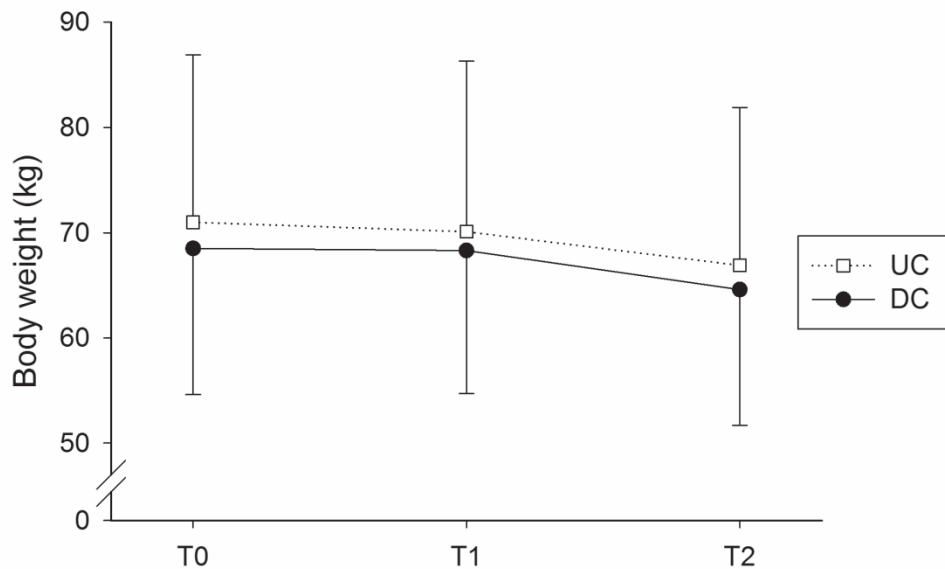


Figure 2. Changes in body weight over time in HNC patients receiving Early Individualized Dietary Counseling (DC) or Usual Care (UC).

T0, first outpatient visit; T1, start of primary anti-tumor treatment; T2, end of primary anti-tumor treatment.

Complications

The prevalence of major postoperative complications was relatively low (12% vs. 18%) with no statistically significant difference between the groups (**Table 3**). Forty-four percent of DC patients and 70% of UC patients experienced minor complications ($p=0.04$). No significant differences were found regarding prevalence of pneumonia, oral infections, or fistula.

During (C)RT, between T1 and T2, 56% of DC and 54% of UC patients were admitted during treatment due to intake failure, malaise, impaired renal function, or dyspnea. In 28% of DC and 19% of UC patients, chemotherapy was postponed or cancelled (NS; **Table 4**).

The majority of patients undergoing (chemo)radiotherapy developed severe acute toxicity in week 4-8 of radiotherapy. Severity of mucositis, xerostomia and dysphagia was not significantly different between groups regarding \geq grade 3 mucositis, \geq grade 2 xerostomia and \geq grade 3 dysphagia (**Table 4**).

Table 3. Postoperative complications and length of stay (days) in HNC patients with surgery receiving Early Individualized Dietary Counseling (DC) or Usual Care (UC).

	DC (n=34)		UC (n=34)		p-value
	n	(%)	n	(%)	
Major complications	4	(12)	6	(18)	0.49
Reoperation	2	(6)	5	(15)	0.23
Readmission < 4 weeks	1	(3)	0	(0)	0.31
ICU admission	1	(3)	2	(6)	0.56
In hospital mortality	0	(0)	0	(0)	-
Minor complications ^a	15	(44)	21	(70)	0.04
Pneumonia	1	(3)	3	(10)	0.24
Oral infection	2	(6)	2	(7)	0.90
Fistula	1	(3)	2	(7)	0.48
Other ^b	12	(35)	15	(50)	0.24
LOS (days) all patients ^c	18.5 ± 11.2		19.3 ± 11.2		0.79
COMMANDO	22.9 ± 6.6		23.8 ± 9.7		0.81
TLE	26.0 ± 12.7		26.8 ± 9.4		0.87
TOE	8.9 ± 2.5		9.4 ± 5.2		0.74

LOS, length of hospital stay; COMMANDO, combined mandibular resection; TLE, total laryngectomy; TOE, transoral excision.

^a UC: n=4 missing data on minor postoperative complications; ^b Other postoperative complications: bleeding, wound dehiscence, anastomotic leakage, intraoral necrosis, skin necrosis, decubitus (neck), refeeding syndrome, edema tongue, lung embolism, dyspnea, cardiac insufficiency, atrial fibrillation, hypertension, hypotension, wound infection donor-site free flap, free flap complication; ^c LOS in mean ± SD.

Length of hospital stay

In both groups, 34 patients underwent surgery (n=10 COMMANDO, n=11 TLE, n=13 TOE). No significant differences were observed between DC and UC patients regarding mean length of hospital stay for the total group (18.5 ± 11.2 compared to 19.3 ± 11.2 days (p=0.79), nor when differentiated for type of surgery (**Table 3**).

Table 4. (Chemo)radiotherapy complications in HNC patients receiving Early Individualized Dietary Counseling (DC) or Usual Care (UC).

	DC (n=57) ^a		UC (n=61)		p-value
	n / n ^b	(%)	n / n ^b	(%)	
Unplanned admission	32 / 57	(56)	33 / 61	(54)	0.82
Postponement of chemotherapy	11 / 39	(28)	8 / 43	(19)	0.30
Acute toxicity ^c					
Mucositis ≥ 3	30 / 48	(63)	33 / 58	(57)	0.56
Xerostomia ≥ 2	36 / 47	(77)	42 / 59	(73)	0.53
Dysphagia ≥ 3	25 / 47	(53)	37 / 59	(63)	0.32

^a DC: n=1 died before start of treatment (CRT), n=1 died in first week of treatment (CRT); n=2 were allocated to RT but never started treatment; ^b n / n = number of cases / number of patients with data on complication; ^c Acute toxicity according to the Common Terminology Criteria for Adverse Events (CTCAEv3.0).

Discussion

This study aimed to determine the effect of early individualized dietary counseling in HNC patients on weight loss, major postoperative and (C)RT complications and length of hospital stay. No effects on any of these primary outcomes could be demonstrated. However, we could demonstrate a significantly lower rate of minor postoperative complications in patients receiving DC.

To our knowledge, no other studies have been performed on the effectiveness of individualized dietary counseling offered in such an early stage of diagnosis. As described earlier, studies have been limited to effects of dietary counseling on nutritional status of HNC patients undergoing (C)RT during antitumor treatment (29). Three studies in patients undergoing radiotherapy showed a beneficial effect of individualized dietary counseling during treatment on weight change during treatment (42), or 12 (43), and 16 (44) weeks after commencing radiotherapy. In HNC patients undergoing surgery, studies have been performed on the effect of pre-treatment nutritional support on nutritional status, complications, length of hospitalization and survival (45-50). However, these RCTs were mostly limited to a pre-treatment time period less than 11 days, and most studies investigated the effect of immunonutrition only (45;46;49;50).

Apart from a significant difference in minor postoperative complications, no effects on primary outcomes could be demonstrated. The mechanism is unclear as other outcomes were not improved. The occurrence of complications could be influenced by a worsened nutritional status in terms of low protein and energy intake, but may also be dependent on other factors, such as factors related to the surgical procedure. Moreover, complications may be related to a deprived immune status caused by insufficient intake of vitamins and trace elements, frequently observed in this patient group with a high prevalence of smoking and drinking habits (51). We speculate that the quality of nutrition with regard to vitamins and trace elements was better in DC patients due to the dietetic involvement, conceivably leading to a lower risk of infections (52), but we have no data to support this hypothesis. Identifying these factors associated with clinical outcomes would provide more insight in the risk of developing weight loss or complications and the role of nutritional status and early dietary intervention in this course.

There are several possible explanations for not finding a treatment effect on the main outcomes. The additional value of dietary counseling was mainly expected to commence in the weeks between diagnosis and start of treatment, as this was the period in which DC patients were systematically consulted by a dietician according to the new treatment protocol. During anti-tumor treatment, all patients, both DC and UC, received the same protocolized nutritional treatment. The time of 4 weeks prior to treatment may have been too limited to improve the patients' nutritional status. In comparison, a study of Van den Berg et al, comparing the effect of individualized dietary counseling and standard care between diagnosis and rehabilitation, could only demonstrate a significant difference in weight loss at two months after treatment (44).

Another factor explaining no treatment effect, is the fact that patients in the UC group could have had dietary counseling and/or ONS between T0 and T1 as well, making both interventions less distinguishable. In the UC group, 26 out of 95 patients had been consulted by a dietician between diagnosis and start of treatment, although their dietary counseling was not as intensive as in the DC group. Moreover, for UC patients with a SNAQ score ≥ 3 or extensive swallowing problems, ONS were prescribed by the senior nurse who had performed the screening. Thirty UC patients had a SNAQ score ≥ 3 , and subsequently should have been prescribed ONS, but this number could have been higher. In the DC group, comparable numbers were found; 32 patients were prescribed ONS and one patient was prescribed tube feeding initiated by the dietician at first outpatient visit.

Ravasco et al. showed that during RT treatment in HNC patients, providing individualized dietary counseling is more effective than adding ONS to the regular diet on nutritional intake, nutritional status, oral symptoms and quality of life in medium term (3 months after end of RT). However, a statistically significant increase in both energy (>300 kcal/day) and protein (>35 g/day) intake was observed in short term (between start and end of RT) in the ONS group (53). Prescribing ONS to our UC population, may have increased the nutritional intake, and therefore reduced the contrast in dietary intervention between the two groups, and could explain the fact that no differences were found on main outcomes.

A major strength of this study is the thorough matching procedure based on 6 different criteria and blinded for any outcome parameter. By matching intervention patients to patients treated for the same health problems in the past, we created two comparable groups at baseline, with regard to gender, age, BMI, tumor location, TNM stage, nutritional status and primary treatment.

There are also several limitations of the study design that need to be discussed. First, as this study was started as a project to improve patient care, we compared our prospectively included DC cohort to a historical cohort of carefully matched patients receiving usual care. Patients in the DC group were included in the study when they had a low BMI, weight loss or if they were at risk of undernutrition due to oral symptoms (dysphagia, chewing problems, or passage problems). Accordingly, all 40 DC patients who were not undernourished according to the classification of SNAQ+BMI, did experience any of these oral symptoms. For patients in the UC group, information on oral symptoms could not structurally be obtained from medical records, so we did not use this as a matching criterion. As patients were matched for the same tumor types and stages, a comparable distribution of oral symptoms was expected. However, as this could not be confirmed by data, UC patients with no undernutrition according to SNAQ+BMI at baseline may have been in a better nutritional condition than those in the DC group.

Secondly, we were partly dependent on data reported in medical records (radiotherapy records, surgical reports and discharge letters). The absence of a treatment effect on weight change may also be related to the method of data collection. Whereas in DC patients weight was measured at all moments, in UC patients, weight could have been measured or recalled. At T0, weight was measured in 31% of UC patients, while this was 74% at T1. From literature it is known that overweight persons tend to underestimate their weight, whereas underweight persons tend to overestimate their weight (54;55). Consequently, relative weight change in UC patients may be biased, but we cannot state towards what direction.

Thirdly, due to the retrospective design, we were unable to compare data regarding changes in muscle mass and muscle strength between groups, as these measurements were not routinely carried out in the historical cohort. Weight loss reflects both loss of fat mass and loss of fat free mass. Finding no significant differences in weight loss does not imply that muscle mass did not change significantly (50;56). Distinguishing between these components gives more insight in a patient's nutritional and physical condition. A better condition (e.g. better lean mass) could be associated with less complications, less tiredness of energy, but also a better quality of life or better survival (57).

Therefore, in future research, a prospective design is recommended, to assess changes in body weight, muscle mass and muscle strength. It would also be worthwhile to study the effects on quality of life.

There is a growing body of evidence that dietary treatment during antitumor treatment has beneficial effects on nutritional status and quality of life(29;58). We therefore expect that dietary treatment initiated at diagnosis would be beneficial as well, but this has not been studied sufficiently. Moreover, there is still no international consensus on the optimal form and timing of nutritional support in this patient group (59;60).

As dietary counseling during treatment is standard care in the Netherlands and several other countries (58;60), and in most centers dietary counseling in the pretreatment period becomes standard care as well, it could be discussed whether performing a RCT to assess the effectiveness of dietary treatment will be ethical. We therefore advise to focus on identifying risk profiles (which patients do benefit most from the provided intervention?) to establish and evaluate an individualized approach.

In conclusion, this study could not demonstrate an effect of early individualized dietary counseling compared to usual care in patients with HNC on weight loss, major surgical and (chemo)radiotherapy complications and length of hospital stay, but showed a lower prevalence of minor post-operative complications. A plausible explanation for this limited effect is the minimal contrast between DC and UC This study is the first to assess the effect of early dietary intervention in HNC patients, and provides a basis for further research.

References

1. Leistra E, van Bokhorst-de van der Schueren MA, Visser M, van der HA, Langius JA, Kruizenga HM. Systematic screening for undernutrition in hospitals: Predictive factors for success. *Clin Nutr* 2013.
2. Leistra E, Neelemaat F, Evers AM et al. Prevalence of undernutrition in Dutch hospital outpatients. *Eur J Intern Med* 2009;20:509-13.
3. Jager-Wittenaar H, Dijkstra PU, Vissink A, van der Laan BF, van Oort RP, Roodenburg JL. Critical weight loss in head and neck cancer-prevalence and risk factors at diagnosis: an explorative study. *Support Care Cancer* 2007;15:1045-50.
4. Larsson M, Hedelin B, Johansson I, Athlin E. Eating problems and weight loss for patients with head and neck cancer: a chart review from diagnosis until one year after treatment. *Cancer Nurs* 2005;28:425-35.
5. Colangelo LA, Logemann JA, Rademaker AW. Tumor size and pretreatment speech and swallowing in patients with resectable tumors. *Otolaryngol Head Neck Surg* 2000;122:653-61.
6. Baracos VE. Cancer-associated cachexia and underlying biological mechanisms. *Annu Rev Nutr* 2006;26:435-61.
7. Richey LM, George JR, Couch ME et al. Defining cancer cachexia in head and neck squamous cell carcinoma. *Clin Cancer Res* 2007;13:6561-7.
8. Silver HJ, Dietrich MS, Murphy BA. Changes in body mass, energy balance, physical function, and inflammatory state in patients with locally advanced head and neck cancer treated with concurrent chemoradiation after low-dose induction chemotherapy. *Head Neck* 2007;29:893-900.
9. Van Cutsem E, Arends J. The causes and consequences of cancer-associated malnutrition. *Eur J Oncol Nurs* 2005;9 Suppl 2:S51-S63.
10. Capuano G, Gentile PC, Bianciardi F, Tosti M, Palladino A, Di PM. Prevalence and influence of malnutrition on quality of life and performance status in patients with locally advanced head and neck cancer before treatment. *Support Care Cancer* 2010;18:433-7.
11. Isenring E, Bauer J, Capra S. The scored Patient-generated Subjective Global Assessment (PG-SGA) and its association with quality of life in ambulatory patients receiving radiotherapy. *Eur J Clin Nutr* 2003;57:305-9.
12. Langius JA, Doornaert P, Spreeuwenberg MD, Langendijk JA, Leemans CR, Schueren MA. Radiotherapy on the neck nodes predicts severe weight loss in patients with early stage laryngeal cancer. *Radiother Oncol* 2010;97:80-5.
13. Matthews TW, Lampe HB, Dragosz K. Nutritional status in head and neck cancer patients. *J Otolaryngol* 1995;24:87-91.
14. van den Berg MG, Rasmussen-Conrad EL, Gwasara GM, Krabbe PF, Naber AH, Merks MA. A prospective study on weight loss and energy intake in patients with head and neck cancer, during diagnosis, treatment and revalidation. *Clin Nutr* 2006;25:765-72.
15. Chencharick JD, Mossman KL. Nutritional consequences of the radiotherapy of head and neck cancer. *Nat Rev Cancer* 1983;51:811-5.
16. Argiles JM. Cancer-associated malnutrition. *Eur J Oncol Nurs* 2005;9 Suppl 2:S39-S50.
17. Norman K, Stobaus N, Zocher D et al. Cutoff percentiles of bioelectrical phase angle predict functionality, quality of life, and mortality in patients with cancer. *Am J Clin Nutr* 2010;92:612-9.

18. van Bokhorst-de van der Schueren MAE, Von Blomberg-van der Flier BME, Riezebos RK et al. Differences in immune status between well-nourished and malnourished head and neck cancer patients. *Clin Nutr* 1998;17:107-11.
19. Guo CB, Zhang W, Ma DQ, Zhang KH, Huang JQ. Hand grip strength: an indicator of nutritional state and the mix of postoperative complications in patients with oral and maxillofacial cancers. *Br J Oral Maxillofac Surg* 1996;34:325-7.
20. Salas S, Deville JL, Giorgi R et al. Nutritional factors as predictors of response to radio-chemotherapy and survival in unresectable squamous head and neck carcinoma. *Radiother Oncol* 2008;87:195-200.
21. van Bokhorst-de van der Schueren M.A.E, van Leeuwen PA, Sauerwein HP, Kuik DJ, Snow GB, Quak JJ. Assessment of malnutrition parameters in head and neck cancer and their relation to postoperative complications. *Head Neck* 1997;19:419-25.
22. Pressoir M, Desne S, Berchery D et al. Prevalence, risk factors and clinical implications of malnutrition in French Comprehensive Cancer Centres. *Br J Cancer* 2010;102:966-71.
23. Langius JA, van Dijk AM, Doornaert P et al. More than 10% weight loss in head and neck cancer patients during radiotherapy is independently associated with deterioration in quality of life. *Nutr Cancer* 2013;65:76-83.
24. Ravasco P, Monteiro-Grillo I, Vidal PM, Camilo ME. Cancer: disease and nutrition are key determinants of patients' quality of life. *Support Care Cancer* 2004;12:246-52.
25. van den Berg MG, Rasmussen-Conrad EL, van Nispen L, van Binsbergen JJ, Merks MA. A prospective study on malnutrition and quality of life in patients with head and neck cancer. *Oral Oncol* 2008;44:830-7.
26. Datema FR, Ferrier MB, Baatenburg de Jong RJ. Impact of severe malnutrition on short-term mortality and overall survival in head and neck cancer. *Oral Oncol* 2011;47:910-4.
27. Van Bokhorst-de van der Schueren MAE, Van Leeuwen PAM, Kuik DJ et al. The impact of nutritional status on the prognoses of patients with advanced head and neck cancer. *Nat Rev Cancer* 1999;86:519-27.
28. Nguyen TV, Yueh B. Weight loss predicts mortality after recurrent oral cavity and oropharyngeal carcinomas. *Nat Rev Cancer* 2002;95:553-62.
29. Langius JA, Zandbergen MC, Eerenstein SE et al. Effect of nutritional interventions on nutritional status, quality of life and mortality in patients with head and neck cancer receiving (chemo)radiotherapy: a systematic review. *Clin Nutr* 2013;32:671-8.
30. Kruizenga HM, Seidell JC, de Vet HC, Wierdsma NJ, van Bokhorst-de van der Schueren MA. Development and validation of a hospital screening tool for malnutrition: the short nutritional assessment questionnaire (SNAQ). *Clin Nutr* 2005;24:75-82.
31. Leistra E, Langius JA, Evers AM et al. Validity of nutritional screening with MUST and SNAQ in hospital outpatients. *Eur J Clin Nutr* 2013;67:738-42.
32. Sergi G, Perissinotto E, Pisent C et al. An adequate threshold for body mass index to detect underweight condition in elderly persons: the Italian Longitudinal Study on Aging (ILSA). *J Gerontol A Biol Sci Med Sci* 2005;60:866-71.
33. Vogel J, Beijer S, Doornink N, Wipkink A. *Handboek voeding bij kanker (handbook nutrition and cancer)*. Utrecht: De Tijdstroom, 2012.
34. Comprehensive Cancer Centers (IKNL). *General Nutrition and Dietary Treatment (2.0)*. 2012.

35. Arends J, Bodoky G, Bozzetti F et al. ESPEN Guidelines on Enteral Nutrition: Non-surgical oncology. *Clin Nutr* 2006;25:245-59.
36. Ribaldo JM, Cella D, Hahn EA et al. Re-validation and shortening of the Functional Assessment of Anorexia/Cachexia Therapy (FAACT) questionnaire. *Qual Life Res* 2001;9:1137-46.
37. Roza AM, Shizgal HM. The Harris Benedict equation reevaluated: resting energy requirements and the body cell mass. *Am J Clin Nutr* 1984;40:168-82.
38. Dutch Institute for Healthcare Improvement CBO. Guideline Perioperative Nutrition. Utrecht; 2007.
39. Sauerwein HP, Strack van Schijndel RJ. Perspective: How to evaluate studies on peri-operative nutrition? Considerations about the definition of optimal nutrition for patients and its key role in the comparison of the results of studies on nutritional intervention. *Clin Nutr* 2007;26:154-8.
40. Frank E, Dunlop AL. What does a patient's outfit weigh? *Fam Med* 2000;32:595-6.
41. Langendijk JA, Doornaert P, Verdonck-de Leeuw IM, Leemans CR, Aaronson NK, Slotman BJ. Impact of late treatment-related toxicity on quality of life among patients with head and neck cancer treated with radiotherapy. *J Clin Oncol* 2008;26:3770-6.
42. Macia E, Moran J, Santos J, Blanco M, Mahedero G, Salas J. Nutritional evaluation and dietetic care in cancer patients treated with radiotherapy: prospective study. *Nutrition* 1991;7:205-9.
43. Isenring EA, Capra S, Bauer JD. Nutrition intervention is beneficial in oncology outpatients receiving radiotherapy to the gastrointestinal or head and neck area. *Br J Cancer* 2004;91:447-52.
44. van den Berg MG, Rasmussen-Conrad EL, Wei KH, Lintz-Luidens H, Kaanders JH, Merks MA. Comparison of the effect of individual dietary counselling and of standard nutritional care on weight loss in patients with head and neck cancer undergoing radiotherapy. *Br J Nutr* 2010;104:872-7.
45. Buijs N, van Bokhorst-de van der Schueren MA, Langius JAE et al. Perioperative arginine-supplemented nutrition in malnourished patients with head and neck cancer improves long-term survival. *Am J Clin Nutr* 2010;92:1151-6.
46. Felekis D, Eleftheriadou A, Papadakis G et al. Effect of perioperative immuno-enhanced enteral nutrition on inflammatory response, nutritional status, and outcomes in head and neck cancer patients undergoing major surgery. *Nutr Cancer* 2010;62:1105-12.
47. Paccagnella A, Morello M, Da Mosto MC et al. Early nutritional intervention improves treatment tolerance and outcomes in head and neck cancer patients undergoing concurrent chemoradiotherapy. *Support Care Cancer* 2010;18:837-45.
48. Rabinovitch R, Grant B, Berkey BA et al. Impact of nutrition support on treatment outcome in patients with locally advanced head and neck squamous cell cancer treated with definitive radiotherapy: a secondary analysis of RTOG trial 90-03. *Head Neck* 2006;28:287-96.
49. Snyderman CH, Kachman K, Molseed L et al. Reduced postoperative infections with an immune-enhancing nutritional supplement. *Laryngoscope* 1999;109:915-21.
50. van Bokhorst-de van der Schueren MA, Quak JJ, von Blomberg-van der Flier BM et al. Effect of perioperative nutrition, with and without arginine supplementation, on nutritional status, immune function, postoperative morbidity, and survival in severely malnourished head and neck cancer patients. *Am J Clin Nutr* 2001;73:323-32.
51. Maggini S, Wintergerst ES, Beveridge S, Hornig DH. Selected vitamins and trace elements support immune function by strengthening epithelial barriers and cellular and humoral immune responses. *Br J Nutr* 2007;98 Suppl 1:S29-S35.

52. Wintergerst ES, Maggini S, Hornig DH. Contribution of selected vitamins and trace elements to immune function. *Ann Nutr Metab* 2007;51:301-23.
53. Ravasco P, Monteiro-Grillo I, Marques VP, Camilo ME. Impact of nutrition on outcome: a prospective randomized controlled trial in patients with head and neck cancer undergoing radiotherapy. *Head Neck* 2005;27:659-68.
54. Connor Gorber S., Tremblay M, Moher D, Gorber B. A comparison of direct vs. self-report measures for assessing height, weight and body mass index: a systematic review. *Obes Rev* 2007;8:307-26.
55. Haverkort EB, de Haan RJ, Binnekade JM, van Bokhorst-de van der Schueren MA. Self-reporting of height and weight: valid and reliable identification of malnutrition in preoperative patients. *Am J Surg* 2012;203:700-7.
56. Weed HG, Ferguson ML, Gaff RL, Hustead DS, Nelson JL, Voss AC. Lean body mass gain in patients with head and neck squamous cell cancer treated perioperatively with a protein- and energy-dense nutritional supplement containing eicosapentaenoic acid. *Head Neck* 2011;33:1027-33.
57. Baracos V, Kazemi-Bajestani SM. Clinical outcomes related to muscle mass in humans with cancer and catabolic illnesses. *Int J Biochem Cell Biol* 2013;45:2302-8.
58. Clinical Oncological Society of Australia (COSA). Evidence Based Guidelines for the Nutritional Management of Adult Patients with Head and Neck Cancer. http://wiki.cancer.org.au/australia/COSA:Head_and_neck_nutrition_guidelines/. Accessed at 29 August 2014.
59. Brown T, Banks M, Hughes B, Kenny L, Lin C, Bauer J. Protocol for a randomized controlled trial of early prophylactic feeding via gastrostomy versus standard care in high risk patients with head and neck cancer. *BMC Nurs* 2014;13:17.
60. Brown T, Findlay M, von DJ et al. Using a wiki platform to promote guidelines internationally and maintain their currency: evidence-based guidelines for the nutritional management of adult patients with head and neck cancer. *J Hum Nutr Diet* 2013;26:182-90.



Chapter 7

General Discussion



The two general aims of this thesis were to identify barriers and enablers for successful implementation of screening and treatment of undernutrition in hospital inpatients, and to investigate possibilities for recognition and the effect of early recognition and treatment of undernutrition in (high risk) outpatient departments. This final chapter summarizes the main findings of the studies presented in this thesis, and provides an overview of the progress made in the recognition and treatment of undernutrition in the hospital inpatient and outpatient setting in the Netherlands. Moreover, methodological considerations will be discussed and implications for future research and clinical practice will be described.

7.1 Recognition and treatment of hospital inpatients

Main findings screening

In 2007, systematic screening for undernutrition in hospitalized patients was introduced as a performance indicator (PI) within the National Benchmarks on Quality of Care of the Dutch Health Care Inspectorate (HCI), obliging all Dutch hospitals to annually report data on the number of patients screened for undernutrition at hospital admission and on the prevalence of undernutrition at admission. In **Chapter 2** the results of the PI undernutrition screening between 2007 and 2010 were evaluated. Both the number of hospitals reporting data as well as the percentage of patients screened at admission have significantly increased over the years. While in 2007 51% of patients was screened at hospital admission this percentage increased to 72% in 2010. This trend continued in the years following; recent data from the Health Care Inspectorate show that screening at hospital admission was 80% in 2012 (**Figure 1**) (1;2). Moreover, a decline in the prevalence of undernutrition according to either MUST or SNAQ screening score was observed; from 18% screened as severely undernourished in 2007 to 14% in 2012 (**Figure 2**).

Both hospital-bound factors and dietician-reported organizational factors for successful screening were defined. Higher screening percentages were found in hospitals with more clinical admissions compared to smaller hospitals (+ 7-14%), in hospitals having regulations on protocol-defined referral to a dietician in case of a positive screening outcome (+ 11%), and in hospitals screening with SNAQ compared to hospitals screening with MUST (+ 9%). The most frequently reported dietician-reported enablers for successful screening were: engagement of nurses and specialists (36%), screening as a mandatory item in (electronic) patient records (35%), and continuous motivation and education by dietitians (35%). The most frequently reported dietician-reported barriers were: experienced high workload of nurses (34%), absence of engagement of nurses and specialists (27%), and absence of clear multidisciplinary responsibility (23%).

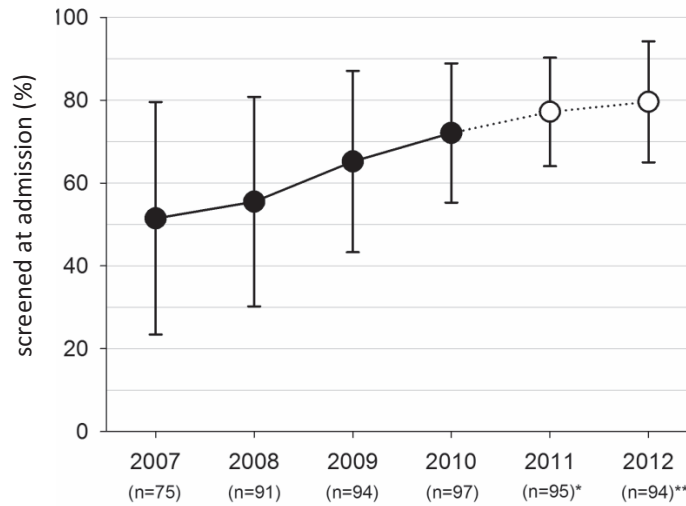


Figure 1. Percentage of patients screened for undernutrition at hospital admission according to the HCI performance indicator data (2007-2012). n represents number of hospitals reporting data.

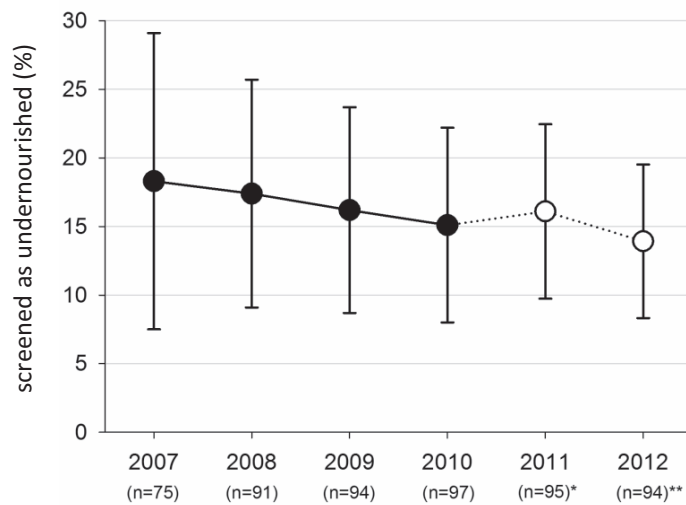


Figure 2. Percentage of patients screened as undernourished according to SNAQ or MUST at hospital admission according to the HCI performance indicator data (2007-2012).

n represents number of hospitals reporting data.

*total number of hospitals in 2011: n=95; **total number of hospitals in 2012: n=94.

Main findings treatment

As of 2008, hospitals are also obliged to report data on treatment of undernutrition to the Health Care Inspectorate. For this quality indicator hospitals provide information on the number of screened undernourished patients with an adequate protein intake (at least 1.2-1.5 g/kg body weight) on day 4 of admission. This indicator only focuses on protein, assuming that an optimal protein intake would ensure optimal energy intake.

In **Chapter 3** patient-related predictors for achieving the recommended protein and energy targets in undernourished hospitalized patients were assessed in one hospital that structurally gathered data on undernutrition treatment in an electronic record. Protein target was defined as ≥ 1.2 g/kg (adjusted for patients with BMI > 27) on day 4 (3-7). Energy target was defined as $\geq 130\%$ of the Harris-Benedict equation on day 4 (4;7-9). Based on all admissions of 2008, only one in four undernourished patients reached the protein target on day 4 of admission and one in three patients reached the energy target. Ninety-one percent of patients who met the protein target, also met the energy target, but inversely, only 66% of patients who met the energy target, met the protein target. These findings validate the hypothesized parallel between optimal protein intake and optimal energy intake and justify the choice of focusing on protein in the PI. Nausea, cancer, acute infections, and a higher BMI were identified as negative predictors, thus lowering the likelihood of achieving the protein and energy targets. Higher age, chronic lung disease and use of tube feeding were identified as positive predictors.

Methodological considerations

Data quality

The performance indicators provide us unique and extensive data over time on the performance of screening and treatment of undernutrition in all Dutch hospitals. Allocating hospitals with the responsibility of reporting data to the Health Care Inspectorate is considered to be a major strength. Not only does it place undernutrition high on the hospital management agenda, gathering data also provides insights into own practice. Moreover, Meijers et al. showed that undernutrition prevalence rates decrease as a result of regular audit and feedback (10). Four hospitals reported screening percentages of 100% which might possibly assume some overestimation. However, one hospital indicated that undernutrition screening is a required field in the electronic patient record, so for every admitted patient a screening score is documented.

The representativeness of data improved throughout the years, as the number of patients and hospitals reported on increased significantly over time; from n=75 hospitals and

n=340.000 patients in 2007 up to all Dutch hospitals (n=97) and n=1.050.000 patients in 2010. In the first years, hospitals were still focused on the implementation of screening and reported data represented only departments where screening was applied. Since most hospitals started the implementation of screening in patients groups most vulnerable for undernutrition, these data are likely to represent the departments with a higher risk of undernutrition. In 2010, still one third of hospitals reported data on a subsample of patients instead of hospital-wide, mainly due to the absence of electronic patient records. In these hospitals the screening percentage was only slightly higher than in hospitals reporting on all admissions (75% vs. 71%, $p=0.33$), though the reported prevalence of undernutrition was significantly higher (19% vs. 13%, $p<0.01$). According to these findings, our reported decrease in prevalence of undernutrition over the years should be interpreted with caution. The introduction of electronic patient records in a growing number of hospitals creates the opportunity to collect data on all admissions more effortlessly. So we expect data to become even more complete in the near future.

Assessment of protein and energy intake

A known issue in measuring food intake is underestimation of actual energy and protein intake (11-13). Especially in hospitalized patients proper estimation of intake is likely to be negatively influenced by the limited time to register food intake amongst the many other responsibilities of hospital nurses. In our study, data on protein and energy intake was registered on a structured intake list by either a trained nutrition assistant or nurse, and evaluated by a dietician on both the third and fourth admission day to check for inconsistencies (in 3% of patients the reported intake on day 3 was used, as data on day 4 was lacking). Even with good protocols on registering intake, in 26% of patients no data on intake were recorded at all. Due to the retrospective character of our study, it was not possible to complete these data or to investigate the reasons for missing data on intake. Missing data on intake were significantly more frequently observed when day 4 was planned to be a weekend day (33% vs 25% missing; OR for complete data 0.67 (0.45-0.98)). Further, we can only speculate that patients with missing data were either (1) in a less severe nutritional condition, thus attaining less attention from nutrition assistants or nurses regarding recording intake, (2) in a more severe disease status, with more focus on other medical parameters than nutrition, or (3) already receiving sip feeding or tube feeding, indicating that there is already attention for nutrition. The fact that in our sample patients with missing data used significantly more sip feeding compared to patients with known intake data is most in line with the latter hypothesis. Yet, this should be documented more precisely so that we can be assured no vulnerable patients are missing out on proper nutritional care.

Implications for further research and clinical practice

Implications for research

We showed that several hospital-bound factors were associated with the results on undernutrition screening and identified barriers and enablers in the process of optimal screening. Moreover, we have demonstrated a variety of patient-bound factors associated with optimal treatment result. We could not objectify the influence of organizational factors concerning responsibilities of planning and managing nutritional care, nutritional knowledge and engagement of all medical staff, or experienced workload. Future research should focus on how to quantify these organizational factors, how they relate to undernutrition screening and treatment.

Since not all hospitals perform the same treatment regimens (e.g. surgical procedures) or treat the same patient groups, variance in undernutrition data at the hospital-level is expected, especially with regard to treatment. For research purposes, it would be valuable to study data on screening and treatment on a patient-level rather than hospital-level. Not only does this support better comparisons between hospitals or between hospital departments, it also creates the opportunity to study a variety of factors associated with screening (e.g. patient age, underlying disease, and prognosis, but admission day) to further improve screening results.

Both protein and energy requirements are dependent on individual energy and protein turnover, influenced by type, severity and phase of illness, nutritional status, and medical treatment (14). It can therefore be discussed whether a set target for all patients is desirable. Furthermore, no studies have been performed to test whether a protein intake of 1.2 g/kg is indeed the optimal intake with regard to disease prognosis and long-term outcomes of the general hospital patient. The optimal route would be to first define the optimal protein target for an individual patient and to assess the effect of reaching this target.

There is ongoing discussion on the optimal protein and energy requirements for (undernourished) hospitalized patients. It may be discussed whether in this patient group the ≥ 1.2 g/kg target that we used according to the HCl standard (1.2-1.5 g/kg body weight) is optimal to maximally stimulate protein synthesis. Regarding protein requirements in hospitalized patients, evidence-based or expert recommendations have been published on using 1.5 g/kg body weight or higher in acute and critically ill patients (4;15) and elderly patients (16;17) (**Table 1**). If we had used a target of 1.5 g/kg in our

sample, only 12% of patients would have met their protein recommendation on the fourth day of admission, implying that more patients do not meet their targets.

Moreover, it could be discussed whether optimal protein intake should be estimated on total body weight or on the amount of fat free mass (FFM). A recent communication of Weijs et al. pointed out the problem of under-feeding of protein in underweight ICU patients when solely looking at total body weight as FFM is assumed to be the true determinant of protein requirements (18). The question arises, whether measuring FFM in all undernourished hospital patients is feasible and reliable. Future research should provide accurate recommendations for both protein and energy based on clinical outcome, with regard to feasibility in clinical practice. Current recommendations on optimal protein levels are mainly based on observational studies and expert opinions. A RCT including three treatment arms (i.e. 0.8 g/kg, 1.2 g/kg and 1.5 g/kg) should be conducted to test which protein level is optimal for undernourished hospital patients with regard to short-term and long-term outcomes.

Table 1. Published recommendations for optimal dietary protein intake in hospitalized (older) adult patients.

Reference	Recommendation
<i>Critical illness</i>	
Sauerwein (2007) (4)	<ul style="list-style-type: none"> • 1.5-1.7 g/kg BW/d in general patients • 1.2 g/kg pre-illness BW/d in severely septic ICU patients
Singer (2009) (15)	<ul style="list-style-type: none"> • 1.3-1.5 g/kg ideal BW/d
<i>Older adults</i>	
Bauer (2013) (16)	<ul style="list-style-type: none"> • 1.0-1.2 g/kg BW/d for healthy older adults • 1.2-1.5 g/kg BW/d for older adults with acute or chronic disease; people with severe illness or injury or with marked malnutrition may need as much as 2.0 g/kg BW/d
Deutz (2014) (17)	<ul style="list-style-type: none"> • 1.0-1.2 g/kg BW/d for healthy older adults • 1.2-1.5 g/kg BW/d for older people who are malnourished or have acute or chronic illnesses; even higher intake for individuals with severe illness or injury

kg, kilogram; BW, body weight; d, day.

Only one in four undernourished patients reached the protein target of 1.2 g/kg body weight on day 4 of admission and one in three patients reached the energy target. Even though the present findings seem to be consistent with other studies, also showing a high

percentage of hospital patients not meeting the nutritional requirements during hospitalization (19-21), this triggers the question whether the advised standards are achievable for hospital patients at day 4 of admission. From other studies, we know that the protein and energy content of the offered hospital meals is insufficient for some patients (19;22), and that high amounts of food are wasted due to inadequate timing of meals, limited menu choice, taste and smell issues, and little time to assist patient with eating (19;22-24). These problems should be tackled to improve nutritional intake for instance by offering smaller portions during the day, introducing a buffet/cart system instead of tray meals, letting patients decide on what to eat at mealtime, or introducing a 24-hour meal service. Good communication and involvement of the kitchen staff is warranted.

The diversity in patient groups may require group-targeted treatment strategies. We found that patients with cancer and patients with acute infections were at highest risk of not meeting the optimal targets. These patient groups may need a different approach in optimizing nutritional intake. Patients with acute infections may benefit directly from dietary counseling and/or ONS or short-term tube feeding. However, for a cancer patient undergoing a severe chemotherapy program it is not feasible to acutely improve nutritional intake. Yet, these patients may benefit from optimal use of antiemetic agents. Also, for patients undergoing surgery the feasibility of achieving the protein targets on day 4 is expected to be lower than for non-surgical patients. For these patients a more aggressive pre- or postoperative tube feeding approach might be beneficial. Still, even with good protocols on patient group-level, we realize that an individual approach may often be necessary.

ONS (29%) and tube feeding (5%) were used to supplement normal oral dietary intake in only one third of all patients. We demonstrated that the use of tube feeding significantly increased the likelihood of reaching the targets. Use of ONS was only univariately associated with a higher likelihood of meeting the protein targets. A recent review on the use of ONS in all healthcare settings shows a significant association between use of ONS and increased protein (+22 g) and energy intake (+314 kcal) (25). However, this does not automatically imply that targets are met.

Protein-enriched 'regular products' may also enhance protein intake in clinical patients. A recent small RCT demonstrated significant increase in protein intake (1.1 ± 0.5 vs. 0.9 ± 0.3 g/kg) by replacing normal bread and yoghurt drinks with protein-enriched bread and -yoghurt drinks in clinically admitted elderly patients (26). These initiatives should be studied on a larger scale.

We identified factors associated with meeting the protein and energy targets on the fourth day of admission. However, we were unable to determine the association of achieving optimal intake with relevant outcomes, such as length of hospital stay. In a post-hoc analysis, we demonstrated that reaching the protein and energy targets at day 4 was associated with a 2 days reduction of length of hospitals stay in all patients, and a 4 days reduction in cancer patients (27). Length of hospitals stay is dependent on various factors such as severity of disease, but also logistic factors such as how quickly home care can be arranged. Due to the retrospective design of the study, we were unable to adjust for those kinds of factors. Randomized trials will be needed to provide insight into the benefits of achieving protein and energy targets on long-term health outcomes, e.g. recovery, readmission rate, changes in nutritional status, lean mass, and physical function, survival, and health care costs.

Implications for clinical practice

The Dutch approach to enhance undernutrition screening appears to be successful. Implementing mandatory screening as a performance indicator, guided by a national implementation program, has been shown to be an effective method to establish undernutrition screening in the hospital setting. Mandatory screening may enhance recognition of undernutrition in other (European) countries as well. In 2010, the Netherlands Society for Clinical Nutrition and Metabolism (NESPEN) received the MNI 'Fight Against Malnutrition' award during the annual European Society for Clinical Nutrition and Metabolism (ESPEN) congress for the Dutch efforts to fight undernutrition in the Netherlands. The award was used to develop an international website (www.fightmalnutrition.eu) describing the implementation strategies of the DMG and providing tool kits, screening tools, and ready to use implementation plans for all healthcare settings.

The identification of barriers and enablers for successful implementation of screening and treatment of undernutrition provides opportunities to improve nutritional care. We demonstrated that screening percentages are influenced by the number of clinical admissions, protocol-defined referral and choice of screening tool. The number of clinical admissions is dependent on the hospital size and the main types of treatments performed, as lower length of stay per treatment increases the number of admissions throughout the year. Opportunities for improving screening results therefore should be exploited in the use of quick-and-easy screening tools and in embedding undernutrition screening in a structured, multidisciplinary implementation plan, including protocol-defined referral.

As a result of the steady increase in hospital screening percentage over the years (>80% in 2012), as of 2013 the focus of the HCI has shifted from hospital screening to outpatient screening. Data on screening at hospital admission are no longer part of the performance indicator. Still, we strongly advise hospitals to record data on undernutrition screening, preferably on department-level, in order to monitor their own achievements. The electronic patient record offers the opportunity to keep track of these results. In the VU University Medical Center, screening results per hospital department are visible monthly in our hospital management system and provide a proper indication on the performance of individual departments.

Moreover, we should focus on how undernutrition treatment can be improved. We demonstrated that 39% of patients had adequate energy intake, whereas only 28% had adequate protein intake. These results stress the importance of focusing on protein in the treatment of undernutrition to minimize the loss of lean body mass, as optimal targets for protein are more difficult to meet than targets for energy. Over the years, reported results on the performance indicator on hospital treatment have improved nationally, but treatment remains substandard. Preliminary results using the 2013 HCI data show a weighed mean of 49% of undernourished patients having an adequate protein intake on day 4. Based on our identification of patient-related predictors for achieving optimal intake, recommendations can be made on:

1. Target patients with cancer and acute infections, as these patient groups are most at risk of not meeting the protein and energy targets;
2. Create awareness among all hospital personnel of the fact that undernutrition can also be present in patients with higher BMI or younger age;
3. Use tube feeding when low intake is expected;
4. Treat nausea effectively, e.g. according to the ERAS protocol (28).

Moreover, both the PI screening study and the protein/energy intake study mention the influence of structural and logistic factors and attitudes of medical staff influencing screening or treatment outcomes. Our findings confirm several studies from the Scandinavian Nutrition Group (29-33); lack of knowledge, lack of interest, lack of clearly defined multidisciplinary responsibility and experienced high workload are amongst barriers for good nutritional therapy. These obstacles should be addressed both bottom-up (by establishing multidisciplinary working groups, training, education and motivation of staff, developing and/or implementing multidisciplinary guidelines in each department) and top-down (continuing mandatory screening and treatment, prioritizing nutrition on

hospital management agenda, developing national guidelines) to (further) improve both screening and treatment (34).

7.2 Screening and treatment of hospital outpatients

Main findings screening

In the absence of clear undernutrition prevalence data in the outpatient setting, we performed a cross-sectional multicenter study in nine hospitals (n=2288 patients) (**Chapter 4**). The prevalence of undernutrition in hospital outpatients was determined to be 5% for severe undernutrition and 2% for moderate undernutrition, and varied significantly among outpatient departments with the highest prevalence in the departments of oral maxillofacial surgery (17%) and oncology (16%), and the lowest prevalence in the department of gynecology (2%).

In this same sample of hospital outpatients, we assessed the diagnostic accuracy of the MUST and SNAQ screening tools to recognize undernutrition (**Chapter 5**). The validity of both MUST and SNAQ was found to be insufficient in this large outpatient sample. The MUST showed a poor positive predictive value (43-59%), identifying too many patients as undernourished who were not, as well as a poor sensitivity for older individuals (58%). The SNAQ showed a low sensitivity (42-45%), thereby identifying too few patients as undernourished. Post-hoc combining SNAQ with BMI resulted in good to excellent diagnostic values (89-100%). However, this very much resembles the used reference method and can thus not be considered a screening tool. It is therefore advised to use BMI and unintentional weight loss to assess undernutrition in the outpatient setting.

Main findings treatment

We showed that undernutrition is largely undertreated in hospital outpatients; in our prevalence study, performed in 2008, only one in 6 undernourished outpatients received dietetic treatment, with the most patients treated in the radiotherapy department (67%) and the least patients treated in the department of surgery (0%).

In **Chapter 6** we evaluated the effect of early nutritional intervention in patients with head and neck cancer. We previously demonstrated that the Head & Neck Surgery department is the outpatient department with the highest prevalence of undernutrition. Patients with a risk for undernutrition received early individualized dietary counseling initiated at first outpatient visit and were compared to a thoroughly matched historical control group

receiving usual care. Post-treatment, no statistically significant differences could be established between the intervention and usual care groups in terms of weight change, major postoperative complications, (chemo)radiotherapy complications or length of hospital stay. However, we could demonstrate a statistically significant lower rate of minor postoperative complications in patients receiving early individualized dietary counseling compared to usual care.

Methodological considerations

Definition of undernutrition

As stated in the general introduction, the absence of a universally accepted definition for undernutrition hampers comparison of studies as they use different criteria to determine undernutrition (35). Moreover, the validity of screening tools cannot be assured in the absence of such a definition (36). Due to progressive insights, in our two studies assessing the prevalence of undernutrition and the diagnostic values of screening instruments in a large outpatient sample, we used slightly different criteria to categorize undernourished patients. The World Health Organization defines normal body weight as BMI 18.5 to 25.0 kg/m², and underweight as BMI < 18.5 kg/m² for all individuals, and does not describe criteria to define 'moderate undernutrition' according to BMI criteria (37). In our study assessing the prevalence of undernutrition in outpatients, we used this strict BMI cut-off point of < 18.5 kg/m² to define undernutrition in all patients. However, recent studies have indicated that for older individuals a cut-off point of < 20.0 kg/m² (or 20.0-22.0 kg/m²) is a more reliable threshold, based on the association between BMI and other anthropometric parameters or mortality (38-40). Therefore, in the study assessing the diagnostic values of screening instruments we used an age-dependent classification with regard to BMI (**Table 2**). Applying this updated classification to the data of Chapter 4 resulted in an increase in the prevalence of severe and moderate undernutrition from respectively 5% and 2% up to 6% and 7%. The use of age-dependent instead of age-independent criteria had no significant effect on the classification high-risk departments.

Table 2. Classification of severe and moderate undernutrition with (Chapter 5) and without (Chapter 4) age-related cut-off values for Body Mass Index.

	Age-independent classification (Chapter 4)	Age-dependent classification (Chapter 5)
<i>Severe undernutrition</i>		
Body Mass Index	• < 18.5 kg/m ²	• < 18.5 kg/m ² (< 65 years) • < 20 kg/m ² (≥ 65 years)
Unintentional weight loss	• > 5% in the last month • > 10% in the last 6 months	• > 5% in the last month • > 10% in the last 6 months
<i>Moderate undernutrition</i>		
Body Mass Index		• 18.5-20 kg/m ² (< 65 years) • 20-22 kg/m ² (≥ 65 years)
Unintentional weight loss	• 5-10% in the last 6 months	• 5-10% in the last 6 months

Choice of screening tools

Following Dutch in-hospital practice, we limited our research to possible screening tools for outpatient screening to the SNAQ and MUST and did not take any other screening tools into account. A recent review comparing the validity of undernutrition screening tools for the hospital in- and outpatient setting identified 32 different screening tools (41). Only two studies in outpatients were identified showing fair criterion validity for MUST and SNAQ compared to a classification of BMI and unintentional weight loss and good validity for the Australian MST screening tool compared to PG-SGA (42;43). Development of new tools seems redundant; therefore we did not try to develop a new screening tool for the outpatient setting. We cannot exclude that other, already existing, instruments can be used to validly screen in outpatients.

Selection of outpatient departments

We performed a multi-center prevalence study and included as many outpatient departments as possible to create a representative sample. However, no geriatric departments were included in the study. This is an omission as the prevalence of undernutrition in these patients is generally high (13-75%) (44;45). For the geriatric outpatient population, screening or assessment with (full) MNA (46) is recommended by national and international guidelines (47;48), although the validity of MNA is not optimal for the older population either (41).

Retrospective design

Our study on the effect of early individualized dietary counseling in patients with head and neck cancer was primarily set up as project to improve quality of care. Consequently, prospectively included patients with a risk for undernutrition were compared to a retrospectively defined historical cohort. Even though patients were carefully and one-to-one matched, we were dependent on the available retrospectively recorded data. Patients in our intervention group were referred for dietetic treatment based on low BMI, unintentional weight loss or presence of oral symptoms related to a higher risk of undernutrition (dysphagia, chewing problems, or passage problems). According to the SNAQ + BMI classification, all patients with 'no undernutrition' (n=40) did experience oral symptoms. Unfortunately, data on oral symptoms were not structurally available for our control group, so we could match patients solely on the SNAQ and BMI items. As patients were matched for the same tumor types and stages, equal oral symptoms are expected in the control and treatment group. Still, this could not be confirmed due to lack of data, implying that control patients with 'no undernutrition' may have been in a slightly better nutritional condition at baseline.

Another disadvantage of the retrospective design was the impossibility of comparing data regarding changes in muscle mass and muscle strength between groups. Jager-Wittenaar et al. showed that, even though achieving sufficient intake could not prevent deterioration of nutritional status, head and neck patients with sufficient intake (≥ 35 kcal and 1.5 grams protein/kg body weight) lost less lean mass during treatment than patients with an insufficient intake (49). Changes in body composition and function (e.g. lean body mass and muscle strength) could be associated with fewer complications, less fatigue, better quality of life and survival (50-53). We presumed that effects of dietary counseling should primarily be found on body weight, followed by physical performance, and finally clinical outcomes. As we could not demonstrate differences with regard to both body weight and major clinical outcomes, following this path, differences in muscle mass and strength are doubtful in this patient sample. Still, we recommend to include measures of muscle mass (DXA, CT, MRI) and muscle strength in future studies to obtain more insight into these parameters.

Nutritional treatment

The early individualized dietary counseling was provided according to the most recent Dutch guidelines. Dietary advice focused on optimal protein and energy intake and relieve of impact of oral symptoms. Due to the individualized character of the study, individual protein targets set for each patient (predominantly ≥ 1.2 - 1.15 g/kg). We were therefore

unable to draw conclusions on a standardized nutritional treatment. Moreover, a significant number of patients in the usual care group appeared to have had (any) dietetic consultation or was prescribed ONS in the period between diagnosis and start of treatment, reducing the contrast in dietetic treatment between both groups. A prospective set up, well-controlled trial would be able to account for these issues.

Implications for further research and clinical practice

Implications for future research

Concerning future research focusing on the recognition and treatment of undernutrition in hospital outpatients several steps need to be undertaken.

1. Establish the most valid screening method

It could be discussed whether it would be worthwhile to study the validity of screening tools (other than SNAQ and MUST) in hospital outpatients. If researchers would like to do so, we advise to examine different already existing tools in the same outpatient population, enabling comparisons between tools, and to focus on quick-and-easy screening tools rather than comprehensive diagnostic screening tools, as screening time is limited in the outpatient setting. Nevertheless, by this approach the problem regarding lack of a gold standard remains.

Based on our findings, we believe it would be more important to focus on the applicability of using BMI and recent unintentional weight loss as an indication for dietetic referral. A recent study of Haverkort et al. on self-reported height and weight in preoperative patients concluded that self-reported data provide highly sensitive information on the classification of undernutrition (54). Thus, for screening purposes the use of self-reported height and weight should be considered. This possibly reflects daily practice in most departments, as this information is already part of most general patient questionnaires, for instance in the preoperative screening departments of the VU University Medical Center. After a positive screening outcome, objective weight measurement (amongst other measurements) should always be performed to confirm low weight, followed by a proper assessment of nutritional status.

In the UK, recent studies have been performed on the validity, reliability and ease-of-use of self-screening in outpatients, including self-measurement of body weight and height (55;56). Results are promising; high agreement with professionals ($k=0.70-1.00$) and high re-retest reliability ($k=0.94-1.00$) were found. The time to complete self-screening was low; 1.29 ± 0.57 min, especially when an electronic system was used (a weighing scale and

stadiometer directly connected to a computer so no BMI calculations were required). Yet, more research is warranted on optimal (electronic) equipment, validity and reliability of self-screening in larger groups of outpatients, including patients with cognitive impairments or physical disabilities, and the feasibility; how should patients be instructed and which patients do not screen themselves?

2. Determine the most optimal multidisciplinary treatment strategy

One of the general principles of screening is that there should be an acceptable treatment for patients with recognized condition (57). Until now, no universally accepted treatment is available when undernutrition is recognized in the outpatient setting, but treatment should always be focused on reducing the negative effects of catabolism and restoring the energy and protein balance in order to minimize the loss of body protein mass (58).

Comparable to the inpatient setting, the optimal protein and energy target for this patient group should be established. Our comparative study in head and neck cancer patients was the first to assess the effect of early dietary counseling in this outpatient group, aiming to optimize or maintain nutritional status prior to start of treatment. Due to the individualized character of treatment, recommended protein and energy goals varied between patients, and no data is available on compliance to the provided dietetic advice. Future studies should focus on a standardized treatment and measure treatment adherence to ensure a 1.2 g/kg protein intake (or higher if recommended).

As the outpatient population is a mixed population, a first step in defining an optimal treatment strategy would be to explore patient characteristics (somatic, functional, psychological and social factors) for each outpatient group to have a better understanding of the underlying causes of undernutrition, e.g. oral symptoms in patients with head and neck cancer, absorption and/or obstruction in gastrointestinal patients, or physical function in elderly patients. Nutritional intervention should be carried out parallel to the required medical treatment, and should always follow a multifactorial approach, focusing on nutritional treatment and underlying factors.

A next step would be to perform a clinical trial providing a standardized nutritional intervention in a homogeneous group of patients. By monitoring somatic, functional, psychological and social factors at the individual level, it can be studied which patients benefit from treatment and which patients do not, based on which specific treatment strategies could be developed.

Finally, patient routings should be objectified in order to develop group-focused treatment protocols. An example of patient routing (involving the outpatient setting) is presented in **Figure 3**. Approximately 18% of every first outpatient visit results into

hospital admission, and 20% results into daycare treatment (e.g. oncological daycare) (59). This indicates that more than half of all first hospital outpatient visits are a (single) outpatient visit: either diagnostics with further treatment in primary care, or (single or longitudinal) treatment in the outpatient setting (e.g. cataract surgery or radiotherapy)). For this last patient group, nutritional treatment strategies in the outpatient setting are warranted. Moreover, depending on diagnosis, a significant amount of patients is expected to visit a medical specialist in the outpatient clinic for follow-up after hospitalization. The effect of (early) undernutrition treatment in the outpatient setting prior to hospital admission or treatment, as well as the effect of post-treatment follow-up in the outpatient setting should be studied. Furthermore, optimal treatment of undernutrition and its underlying causes in primary care needs to be established, along with development of protocols on bi-directional transmural nutritional support in the future.

3. Embedding recognition and treatment in hospital outpatients in practice

Within the treatment of undernutrition detected in the outpatient setting, different treatment strategies should be established for patients with an expected hospital admission according to their diagnosis and prognosis and patients returning to primary care. Multidisciplinary protocols should be developed for all 'patient routings'. The 'National Primary Care Cooperation Agreement Undernutrition' (in Dutch: Landelijke Eerstelijns Samenwerkings Afspraak: LESA) Introduced by the Dutch College of General Practitioners in 2010 (60), encloses the collaboration between general practitioners, (district) nurses and dieticians in the recognition and treatment of undernutrition in primary care, and can be used as a template for other patients routings.

Implications for clinical practice

The approximation of absolute numbers of undernourished patients visiting the hospital outpatient setting at least once a year is visualized in **Figure 7.4**. Numbers are based on the prevalence rates calculated with the age-dependent criteria (see Table 7.1) and the most recent CBS data (2012) regarding the number of outpatient medical contacts in Dutch hospitals (61). Approximately 260.000 undernourished patients visit the outpatient setting at least once a year. These high numbers strengthen the importance of recognition of undernutrition in this setting.

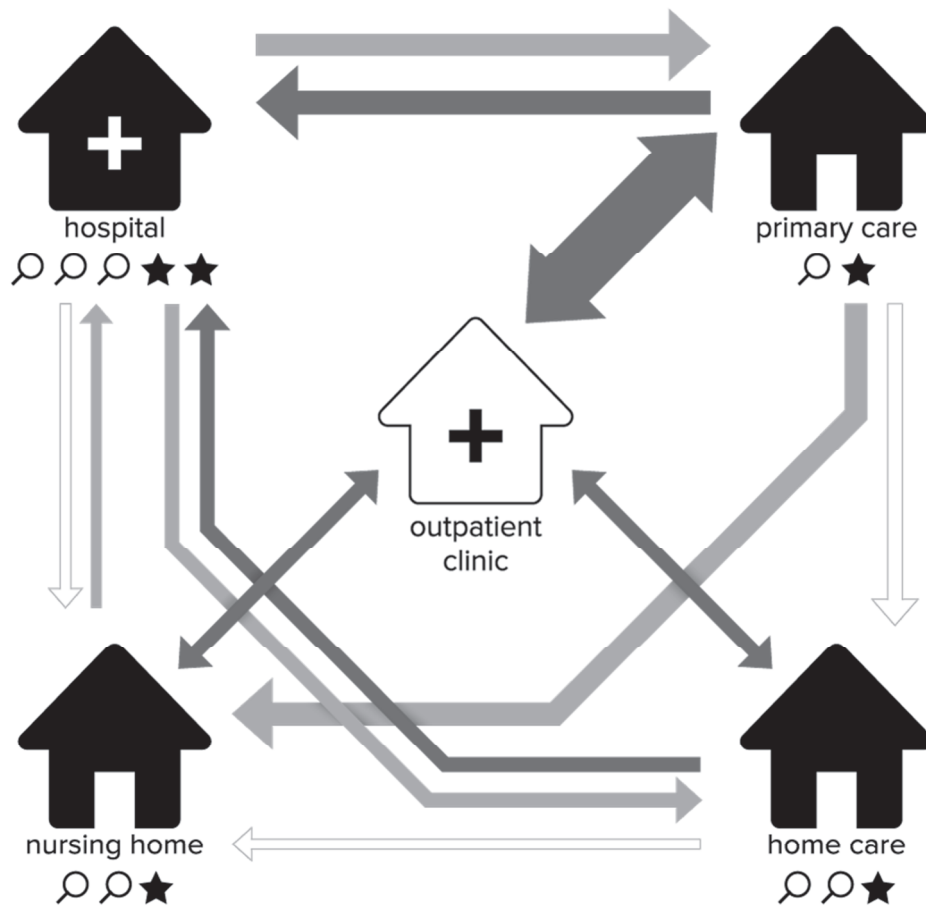


Figure 3. Overview of 'patient routings'.

Dark grey arrows: outpatient clinic involved; light grey arrows: outpatient clinic possible; white arrows: outpatient clinic not expected.

🔍 indicates level of screening in the setting; ★ indicates level of treatment in the setting.

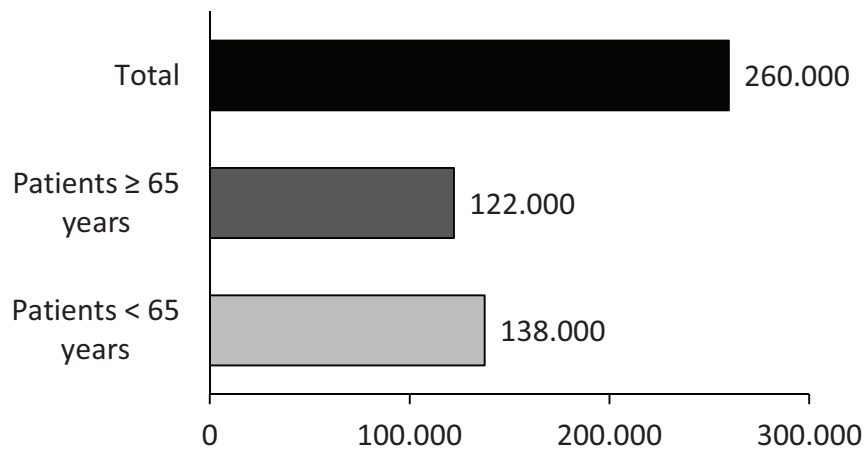


Figure 4. Estimated absolute numbers of undernourished patients visiting the hospital outpatient setting at least once a year.*

*Based on most recent CBS data on number of outpatient medical contacts in 2012 (61) and age-dependent criteria in Table 1.

According to the most recent data from the Netherlands' Association of Hospitals, the number of first outpatient visits in Dutch hospitals in 2012 was 9.8 million (59). Performing nutritional screening in all these patients would result in an extensive increase in workload, unless patients can screen themselves. As described earlier, more research is warranted on the use of self-screening in this setting. Until these techniques are available for implementation, we should focus on detecting the patients most at risk. Our classification of high-risk outpatient departments can be used to prioritize departments to start implementation of nutritional screening and treatment (i.e. oral maxillofacial surgery, oncology, rehabilitation, gastroenterology, pulmonology, but also preoperative assessment (7) and geriatric assessment departments (62)).

Following the performance indicators for hospital screening and treatment of undernutrition, in 2013, the Health Care Inspectorate introduced screening for undernutrition in the preoperative outpatient setting to the National Benchmarks on Quality of Care (7;63). In 2014, the undernutrition performance indicators have been extended with screening for undernutrition in the geriatric outpatient setting (62;64). Because we concluded that SNAQ and MUST screening tools cannot be used in the outpatient setting, the identification of undernutrition should ideally be performed based on measured BMI and recent unintentional weight loss. Embedding outpatient screening

in this set of quality indicators is expected to ensure consistent screening in these outpatient departments over the forthcoming years.

Even though the HCI focus is shifting from inpatient to outpatient screening, inpatient screening still needs to be ensured as not all patients visit the outpatient setting prior to (acute) hospital admission. Moreover, patients who were classified as 'not at risk' during outpatient screening, could develop undernutrition in the time between outpatient visit and hospital admission or between 2 consecutive outpatient visits. Embedding nutritional status in electronic patient records may facilitate both screening procedures and monitoring of screening and treatment results.

Key messages

- The performance indicators on in-hospital undernutrition screening and treatment combined with a national implementation program were essential for implementation and maintenance of undernutrition screening and treatment in the hospital setting, improving screening results up to 80%. This top-down approach is also warranted in other settings.
- Results on undernutrition treatment with regard to adequate protein intake on day 4 of admission still need improvement. Predictors of not achieving the targets (nausea, cancer, acute infections, higher BMI and younger age) should be addressed. Optimal treatment goals should be defined.
- New opportunities should be encountered in outpatient screening as health care is shifting from clinical hospital care towards outpatient care.
- Depending on criteria used, 5-6% of hospital outpatients are severely undernourished and 2-7% are moderately undernourished. This adds up to a considerable number of patients each year, meaning that outpatient recognition and treatment of undernutrition requires a structural approach.
- Early recognition of undernutrition in hospital outpatients should preferably be based on (measured) BMI and weight loss, as screening with SNAQ and MUST appears invalid for this setting.
- In a study with a retrospective design we observed little effect of an early individualized dietary treatment in patients with head and neck cancer. Risk profiles should be identified to establish and evaluate an individualized approach.
- Height, weight and (recent) unintentional weight loss should become a basic 'patient characteristic' of all patients in every health care setting so that objectively assessed changes in weight can be monitored over time and across care settings.

References

1. Dutch Health Care Inspectorate. 'Het resultaat telt' (The result counts) 2011. Utrecht; 2013.
2. Dutch Health Care Inspectorate. 'Het resultaat telt' (The result counts) 2012. Utrecht; 2014.
3. Dutch Health Care Inspectorate. Performance Indicators for Risk Steering Supervision 2008. Utrecht; 2007.
4. Sauerwein HP, Strack van Schijndel RJ. Perspective: How to evaluate studies on peri-operative nutrition? Considerations about the definition of optimal nutrition for patients and its key role in the comparison of the results of studies on nutritional intervention. *Clin Nutr* 2007;26:154-8.
5. Ishibashi N, Plank LD, Sando K, Hill GL. Optimal protein requirements during the first 2 weeks after the onset of critical illness. *Crit Care Med* 1998;26:1529-35.
6. Shaw JH, Wildbore M, Wolfe RR. Whole body protein kinetics in severely septic patients. The response to glucose infusion and total parenteral nutrition. *Ann Surg* 1987;205:288-94.
7. Dutch Institute for Healthcare Improvement CBO. Guideline Perioperative Nutrition. Utrecht; 2007.
8. Roza AM, Shizgal HM. The Harris Benedict equation reevaluated: resting energy requirements and the body cell mass. *Am J Clin Nutr* 1984;40:168-82.
9. Weijs PJ, Kruijsenga HM, van Dijk AE et al. Validation of predictive equations for resting energy expenditure in adult outpatients and inpatients. *Clin Nutr* 2008;27:150-7.
10. Meijers JM, Candel MJ, Schols JM, van Bokhorst-de van der Schueren MA, Halfens RJ. Decreasing trends in malnutrition prevalence rates explained by regular audits and feedback. *J Nutr* 2009;139:1381-6.
11. Dodd KW, Guenther PM, Freedman LS et al. Statistical methods for estimating usual intake of nutrients and foods: a review of the theory. *J Am Diet Assoc* 2006;106:1640-50.
12. Freedman LS, Midthune D, Carroll RJ et al. Adjustments to improve the estimation of usual dietary intake distributions in the population. *J Nutr* 2004;134:1836-43.
13. Poslusna K, Ruprich J, de Vries JH, Jakubikova M, van't Veer P. Misreporting of energy and micronutrient intake estimated by food records and 24 hour recalls, control and adjustment methods in practice. *Br J Nutr* 2009;101 Suppl 2:S73-S85.
14. Elia M. Insights into energy requirements in disease. *Public Health Nutr* 2005;8:1037-52.
15. Singer P, Berger MM, Van den Berghe G et al. ESPEN Guidelines on Parenteral Nutrition: intensive care. *Clin Nutr* 2009;28:387-400.
16. Bauer J, Biolo G, Cederholm T et al. Evidence-based recommendations for optimal dietary protein intake in older people: a position paper from the PROT-AGE Study Group. *J Am Med Dir Assoc* 2013;14:542-59.
17. Deutz NE, Bauer JM, Barazzoni R et al. Protein intake and exercise for optimal muscle function with aging: Recommendations from the ESPEN Expert Group. *Clin Nutr* 2014;33:929-36.
18. Weijs PJ, Sauerwein HP, Kondrup J. Protein recommendations in the ICU: g protein/kg body weight - which body weight for underweight and obese patients? *Clin Nutr* 2012;31:774-5.

19. Dupertuis YM, Kossovsky MP, Kyle UG, Raguso CA, Genton L, Pichard C. Food intake in 1707 hospitalised patients: a prospective comprehensive hospital survey. *Clin Nutr* 2003;22:115-23.
20. Hiesmayr M, Schindler K, Pernicka E et al. Decreased food intake is a risk factor for mortality in hospitalised patients: the NutritionDay survey 2006. *Clin Nutr* 2009;28:484-91.
21. Sullivan DH, Sun S, Walls RC. Protein-energy undernutrition among elderly hospitalized patients: a prospective study. *JAMA* 1999;281:2013-9.
22. Barton AD, Beigg CL, Macdonald IA, Allison SP. High food wastage and low nutritional intakes in hospital patients. *Clin Nutr* 2000;19:445-9.
23. Jensen GL, Mirtallo J, Compher C et al. Adult starvation and disease-related malnutrition: a proposal for etiology-based diagnosis in the clinical practice setting from the International Consensus Guideline Committee. *JPEN J Parenter Enteral Nutr* 2010;34:156-9.
24. Munk T, Seidelin W, Rosenbom E et al. A 24-h a la carte food service as support for patients at nutritional risk: a pilot study. *J Hum Nutr Diet* 2013;26:268-75.
25. Cawood AL, Elia M, Stratton RJ. Systematic review and meta-analysis of the effects of high protein oral nutritional supplements. *Ageing Res Rev* 2012;11:278-96.
26. Stelten S, Dekker IM, Runday EM et al. Protein-enriched 'regular products' and their effect on protein intake in acute hospitalized older adults; a randomized controlled trial. *Clin Nutr* 2014;Epub ahead of print.
27. Weijs PJM, Leistra E, Schipper M, Oostenbrink J, Kruijenga HM. Achieving protein and energy targets in malnourished hospitalized patients on day 4 of admission improves length of hospital stay (OP050). *Clinical Nutrition Supplements* 2011;6:21 (abstr).
28. Fearon KC, Ljungqvist O, von Meyenfeldt MF et al. Enhanced recovery after surgery: a consensus review of clinical care for patients undergoing colonic resection. *Clin Nutr* 2005;24:466-77.
29. Kondrup J, Johansen N, Plum LM et al. Incidence of nutritional risk and causes of inadequate nutritional care in hospitals. *Clin Nutr* 2002;21:461-8.
30. Lindorff-Larsen K, Hojgaard RH, Kondrup J, Staun M, Ladefoged K. Management and perception of hospital undernutrition-a positive change among Danish doctors and nurses. *Clin Nutr* 2007;26:371-8.
31. Mowe M, Bosaeus I, Rasmussen HH, Kondrup J, Unosson M, Irtun O. Nutritional routines and attitudes among doctors and nurses in Scandinavia: a questionnaire based survey. *Clin Nutr* 2006;25:524-32.
32. Mowe M, Bosaeus I, Rasmussen HH et al. Insufficient nutritional knowledge among health care workers? *Clin Nutr* 2008;27:196-202.
33. Johansson U, Rasmussen HH, Mowe M, Staun M. Clinical nutrition in medical gastroenterology: room for improvement. *Clin Nutr* 2009;28:129-33.
34. Holst M, Beermann T, Mortensen MN, Skadhauge LB, Lindorff-Larsen K, Rasmussen HH. Multi-modal intervention improved oral intake in hospitalized patients. A one year follow-up study. *Clin Nutr* 2014; Epub ahead of print.
35. Meijers JM, van Bokhorst-de van der Schueren MA, Schols JM, Soeters PB, Halfens RJ. Defining malnutrition: mission or mission impossible? *Nutrition* 2010;26:432-40.

36. Health Council of the Netherlands. Malnutrition in the elderly. The Hague; 2011. Report No.: publication no. 2011/32.
37. World Health Organization. Obesity: Preventing and Managing the Global Epidemic. Geneva; 1998.
38. Elia M, Stratton RJ. An analytic appraisal of nutrition screening tools supported by original data with particular reference to age. *Nutrition* 2012;28:477-94.
39. Campillo B, Paillaud E, Uzan I et al. Value of body mass index in the detection of severe malnutrition: influence of the pathology and changes in anthropometric parameters. *Clin Nutr* 2004;23:551-9.
40. Sergi G, Perissinotto E, Pisent C et al. An adequate threshold for body mass index to detect underweight condition in elderly persons: the Italian Longitudinal Study on Aging (ILSA). *J Gerontol A Biol Sci Med Sci* 2005;60:866-71.
41. van Bokhorst-de van der Schueren MA, Guaitoli PR, Jansma EP, de Vet HC. Nutrition screening tools: does one size fit all? A systematic review of screening tools for the hospital setting. *Clin Nutr* 2014;33:39-58.
42. Neelemaat F, Kruizenga HM, de Vet HC, Seidell JC, Buttermann M, van Bokhorst-de van der Schueren MA. Screening malnutrition in hospital outpatients. Can the SNAQ malnutrition screening tool also be applied to this population? *Clin Nutr* 2008;27:439-46.
43. Isenring E, Cross G, Daniels L, Kellett E, Koczwara B. Validity of the malnutrition screening tool as an effective predictor of nutritional risk in oncology outpatients receiving chemotherapy. *Support Care Cancer* 2006;14:1152-6.
44. Saka B, Kaya O, Ozturk GB, Erten N, Karan MA. Malnutrition in the elderly and its relationship with other geriatric syndromes. *Clin Nutr* 2010;29:745-8.
45. van Bokhorst-de van der Schueren M, Lonterman-Monasch S, de Vries O, Danner S, Kramer M, Muller M. Prevalence and determinants for malnutrition in geriatric outpatients. *Clin Nutr* 2013;32:1007-11.
46. Guigoz Y, Lauque S, Vellas BJ. Identifying the elderly at risk for malnutrition. The Mini Nutritional Assessment. *Clin Geriatr Med* 2002;18:737-57.
47. Kondrup J, Allison SP, Elia M, Vellas B, Plauth M. ESPEN guidelines for nutrition screening 2002. *Clin Nutr* 2003;22:415-21.
48. van Asselt DZ, van Bokhorst-de van der Schueren MA, van der Cammen TJ et al. Assessment and treatment of malnutrition in Dutch geriatric practice: consensus through a modified Delphi study. *Age Ageing* 2012;41:399-404.
49. Jager-Wittenaar H, Dijkstra PU, Vissink A et al. Changes in nutritional status and dietary intake during and after head and neck cancer treatment. *Head Neck* 2011;33:863-70.
50. Antoun S, Baracos VE, Birdsell L, Escudier B, Sawyer MB. Low body mass index and sarcopenia associated with dose-limiting toxicity of sorafenib in patients with renal cell carcinoma. *Ann Oncol* 2010;21:1594-8.
51. Baracos V, Kazemi-Bajestani SM. Clinical outcomes related to muscle mass in humans with cancer and catabolic illnesses. *Int J Biochem Cell Biol* 2013;45:2302-8.

52. Martin L, Birdsell L, MacDonald N et al. Cancer cachexia in the age of obesity: skeletal muscle depletion is a powerful prognostic factor, independent of body mass index. *J Clin Oncol* 2013;31:1539-47.
53. Tan BH, Birdsell LA, Martin L, Baracos VE, Fearon KC. Sarcopenia in an overweight or obese patient is an adverse prognostic factor in pancreatic cancer. *Clin Cancer Res* 2009;15:6973-9.
54. Haverkort EB, de Haan RJ, Binnekade JM, van Bokhorst-de van der Schueren MA. Self-reporting of height and weight: valid and reliable identification of malnutrition in preoperative patients. *Am J Surg* 2012;203:700-7.
55. Cawood AL, Elia M, Sharp SK, Stratton RJ. Malnutrition self-screening by using MUST in hospital outpatients: validity, reliability, and ease of use. *Am J Clin Nutr* 2012;96:1000-7.
56. McGurk P, Jackson JM, Elia M. Rapid and reliable self-screening for nutritional risk in hospital outpatients using an electronic system. *Nutrition* 2013;29:693-6.
57. Wilson JMG and Jungner G. Principles and practice of screening for disease. Geneva: WHO; 1968.
58. Jensen GL, Bistrian B, Roubenoff R, Heimbürger DC. Malnutrition syndromes: a conundrum vs continuum. *JPEN J Parenter Enteral Nutr* 2009;33:710-6.
59. NVZ Dutch Hospitals Association. Zorg Loont; Brancherapport algemene ziekenhuizen. Utrecht; 2013.
60. van Avendonk MJ, Mensink PA, Drenthen AJ, van Binsbergen JJ. Primary care and public health a natural alliance? The introduction of the guidelines for obesity and undernutrition of the Dutch College of General Practitioners. *Fam Pract* 2012;29 Suppl 1:i31-i35.
61. CBS Statline Netherlands. Medical contacts, hospitalisation, medicines, sex and age. <http://statline.cbs.nl>. Accessed at 1 May 2014.
62. van Asselt DZB, van Bokhorst-de van der Schueren MAE, Olde Rikkert MG. Leidraad Ondervoeding bij de Geriatrische Patiënt (Guideline Assessment and Treatment of Malnutrition in Geriatric Practice). Utrecht: Academic Pharmaceutical Productions bv, 2010.
63. Dutch Health Care Inspectorate. Performance Indicators for Risk Steering Supervision 2013. Utrecht; 2012.
64. Dutch Health Care Inspectorate. Performance Indicators for Risk Steering Supervision 2014. Utrecht; 2013.